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**ELECTRONICS  
TODAY  
INTERNATIONAL**

# SUPERB AM TUNER

Using the  
3080 IC

Win a  
Dick Smith  
Computer!



## Exploring the comets

**Hi-Fi:** Recording tape and tape recording  
Review of the dbx 3BX dynamic range enhancer



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# ELECTRONICS TODAY INTERNATIONAL

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Category B

## QUICK INDEX

### FEATURES:

- 14 Solar Propulsion & Cometary Exploration
- 58 Using the 3080 IC
- 94 Win a Dick Smith System 80 Computer !
- 28 Special Offer on EMI Reel to Reel Tape
- 97 Floppy Disks — Special Reader Offer

### SOUND SECTION:

- 119 Sound News
- 124 Recording Tape & Tape Recording
- 138 The 3BX Dynamic Range Enhancer by dbx
- 144 Celef Mini Professional S.M. Speakers
- 114 Dindy High Energy Cassettes — Special Reader Offer

### PROJECT SECTION:

- 19 475: Quality AM Tuner
- 36 326: Expanded Scale LED Voltmeter
- 47 457: Scratch and Rumble Filter
- 31 Short Circuits: Touch Switch
- 43 Short Circuits: Magic Candle
- 99 Short Circuits: AIM65 Cassette Interface Mod.
- 72 Ideas For Experimenters
- 79 Shoparound

THE IMPOSITION of duty on imported electronic products, whether items of complete equipment or components, is a complex and many-faceted affair. The object of import duty is, ostensibly, to protect Australian industry, technical skills, jobs etc. However, I have heard of, and been involved in, a variety of situations over the years that lead me to believe that our customs laws are framed and administered by people who (a) do not necessarily understand the 'industry' or 'technical skills' they seek to protect so zealously, and (b) do not understand or attempt to work out the consequences of removing or applying duty on particular items.

Recently, we heard that some keen and over-zealous customs official discovered that **one** local firm was assembling record player cartridges. The duty on imported items promptly jumped from **2% to 35%!** It would have been fair enough, perhaps, if the firm employed a large number of people solely engaged on that task. However, said firm had been in business **for several decades** (no prior protection) and employed fewer people than could be counted on one hand. The local product does not compete with the huge variety of imported cartridges, yet the duty was applied unilaterally . . . to protect whom? This ludicrous situation was pointed out to the customs authorities, forcefully and often, and the duty was removed some five weeks after it was applied.

The manner in which the customs authorities categorise items often shows abysmal ignorance of the 'industry' they're attempting to 'protect'. Take hi-fi amplifiers for example. Currently, customs don't differentiate between hi-fi amps and PA equipment. As a great deal of PA and sound re-inforcement equipment is currently manufactured in Australia, and there is strong competition in that market, customs protection seems in order but domestic hi-fi equipment is entirely a different matter. There are a few very small Australian companies producing hi-fi amplifiers but their combined output — even **with** tariff protection — is miniscule. Why should the tariff 'umbrella' cover both sorts of equipment? There may be difficulties in where you draw the line, but I believe that could be resolved after a little intelligent investigation.

It seems the whole subject is in serious need of review.



Roger Harrison  
Editor



## advertisers

Anderson Digital	128
AP Products	130
AWA	136
Ampec Engineering	27
Applied Technology	96
Audio Engineers	146
Aust. Guarantee Corp.	30
Aust. General Electric	62
AED	80
Audio Design	108
Audax Loudspeakers	150
Audio KIts	56
Andrews Communications	6
Advanced Electronic Systems	82
Aust. Govt. Dept. Transport	100
Bose Aust.	148
Barratt Lighting	42
BASF	111
Bell Instruments	53
Bright Star Crystals	56
Belle Lumiere	73
Box Hill Tech.	43
Convoy	116, 117, 118, 133, 143
C&K Electronics	10
Comp-Soft Micro	6
C.I.S.A.	78
Consolidated Marketing	83
Calculator & Computer Dist.	84
Chadwick Audio	108
Christle Rand	6
Defense Force Recruiting	71
Diggerman Electronics	77
Dick Smith	22, 32, 33, 57, 88, 90, 93, 105
Dicker Data Projects	103
Danish Hi-Fi	150
David East	65
Delsound	18
Dynaudio	70
Ellistronics	44, 45
Electro-Voice Aust.	143
Electronic Agencies	74
Emona Enterprises	69
Electrocraft	18
Electronic Components & Equip.	65
Edible Electronics	70
Ferguson Transformers	77
General Electronic Services	34
Goldring	123, 137
Hagemeyer	2, 155
Home Computer Show	92
H.F. Coates	65
Holden Wasp	73
Insound	81
John F. Rose	13
Jaycar	109
J.R. Components	76
Logic Shop	18
Looky Video	82
Magraths	7
Maruni Corp.	122
Micro 80	106
Micro Gear	79
National Panasonic	156
Northpoint Hi-Fi	112
Pre Pak	52
Philips Elcoma	76, 113
Plessey Components	70
Rod Irving	50, 66, 85
Radio Despatch	41
Radio Parts	73
Sevien Lighting	29
Sony	120
Sansui	129
Scope Labs	11
Seeforth	10
SM Electronics	40, 41
Systems Automation	100, 101
Speedy Communications	46
S.I. Microcomputers	84
Software Source	31
Standard Components	12
Tasman Electronics	53
The Byte Shop	41
Vicom International	35
Video Classics	56
Warburton Frankl.	98
Woodland Audio	76
Zero One Electronics	102



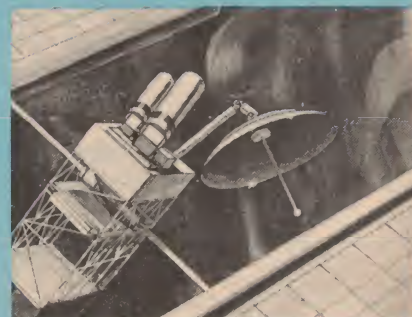
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### COVER

Naked and unashamed! A topless view of our AM tuner project whose most intimate details are revealed later in these pages. Photo by Ivy Hansen.

## features



### COMETARY EXPLORATION

14

Solar energy can be used to power ion propulsion rocket motors for investigation of objects — including comets — in deep space.

### USING THE 3080 IC

58

The variable transconductance of this op-amp makes it useful in a host of applications, including electronic music and sound effects.



### CONTEST — WIN A DICK SMITH SYSTEM 80 MICROCOMPUTER

94

Just answer a few simple (and one or two not so simple) questions and you could be the lucky winner of this versatile little micro.

## news

### NEWS DIGEST

8

Hailing Halley's Comet; Integrated CCTV; Video makes big in little estate agent; New Ceduna earth station; Errata etc.

### PRINTOUT

86

Micro with 10M hard disk; EPROM data loggers; S100 interface for System 80; Single board video terminal, and more...

### COMMUNICATIONS NEWS

104

Amateurs can influence communications receiver design; Europe-Japan on 50 MHz.

### SHORTWAVE LOGGINGS

107

Where does Radio Moscow transmit from?; Peak reception from Angola; Guide to reporting in Spanish.

## projects

### 326: EXPANDED SCALE LED VOLTMETER

36

Keep tabs on your car battery and electrical system with our expanded scale LED bargraph voltmeter. Easy to read and easy to build.





**475: AM TUNER** 19  
AM broadcast stations are now transmitting with a 15 kHz audio bandwidth and you can get remarkably good reception with a good quality tuner. This design is fairly simple but gives great results.



**457: SCRATCH AND RUMBLE FILTER** 47  
Do some of your records sound like they've been sandpapered? Bring back most of the listening pleasure with this filter network.

**SHOPAROUND** 79

## sound

**SOUND NEWS** 119  
BASF build a better cassette body; dbx encoded records; Heat pipes for cooling transistors; Integrated audio test kit, and more . . .

**RECORDING TAPE AND TAPE RECORDING** 124  
Mysteries of the magnetic medium explained. We explain the physical limitations of tapes and how they are overcome in practice. Plus a section on tape recorder hygiene.

**DBX 3BX DYNAMIC RANGE EXPANDER** 138  
Will this sophisticated unit make all your normal records sound like direct cuts? Read our review and find out.



**CELEF MINI PROFESSIONAL S.M. SPEAKERS** 144  
An expensive pair of small speakers. Are they worth the money?

**CLEANING TAPE OFFER** 135

**DINDY CASSETTE OFFER** 114  
High energy tapes at low, low prices.

**EMI RECORDING TAPE OFFER** 28  
Don't miss this opportunity to get some top reel to reel tapes.

## general

**SHORT CIRCUITS**  
Touch switch 31  
Magic candle novelty 43  
AIM65 cassette interface mod. 99

**IDEAS FOR EXPERIMENTERS** 72  
Combination lock, electronic casino etc.

**IONOSPHERIC PREDICTIONS** 110

**LETTERS** 81

**FLOPPY DISK OFFER** 97  
Special for readers into microcomputing.

**MAIL ORDER BOOKS FROM ETI** 54  
Beginners' books, data books, circuit books etc.

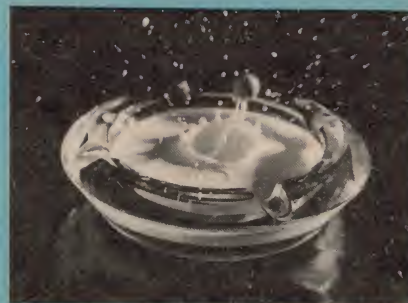
**MINI MART** 144

**KITS FOR PROJECTS** 152

**ETI SERVICES** 153

**DREGS** 154

## next month



### SOUND AND LIGHT OPERATED FLASH TRIGGER

It's many years since we did a project of this sort, so we thought it about time to look at the subject afresh. This one's simple to build, features trigger delay and you can do all sorts of tricks with it.

### ELECTRONIC THERMOMETER

This simple project is suited to measuring air temperature over the range from  $-10^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$  or  $-10^{\circ}\text{C}$  to  $+90^{\circ}\text{C}$  according to your fancy. It's great as an electronic thermometer or it can be used to check air conditioners, heating systems etc.



### PROJECT GALILEO

In our January issue we reported on Voyager 2's visit to Jupiter. This time we look at the next mission to the giant planet which will involve international co-operation.

### NAKAMICHI 482 STEREO CASSETTE DECK

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Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.



## EXCITING NEW POCKET SIZE DIGITAL MULTIMETERS

'SANSEI' 2200A DIGITAL MULTIMETER, with a 3½ digit LCD display. This new Multimeter has now been released, with an accuracy of 0.3% for under \$100. Other features include auto polarity, low battery and overrange indication. Supplied with Test Leads, spare fuse and battery.

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★ M400E2 30ch Scanner.....\$445

★KENWOOD TS-130S Transceiver only.....\$745

★YAESU FT-707 Transceiver only....\$725

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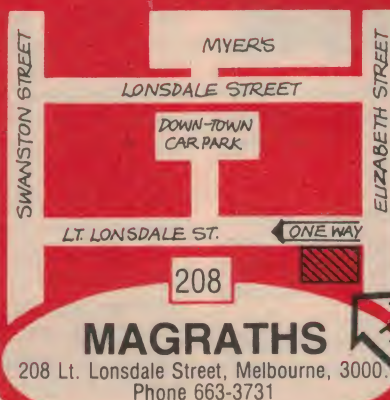
● IV: Using the 8255-type programmable interface chip, \$10.50 ● V & VI: A combined approach to digital electronics and micro-computer interfacing, \$11.50 e.a. ● VII: Microcomputer — Analog Converter Software and Hardware Interfacing, \$10.50 ● VIII: Assembly language programming for 8080 processors, \$11.00

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## Video makes big in little estate agent



Sydney estate agent, Bigge and Little, of Willoughby, have installed video recording and play back equipment so that customers may preview a variety of properties without the hassle of having to inspect them all personally.

Having to inspect, say, 30 or 40 properties is a daunting prospect to a customer in search of a home to suit their tastes and budget.

Property descriptions on an estate agent's books are of necessity brief and that old saw of "a picture is worth a thousand words" prompted the proprietor of Bigge and Little, Graham White, to purchase the video equipment.

They bought a National portable video cassette recorder and portable camera with which they film not just the property inside and out — 'warts and all' — but the locale as well. In this way, customers can get quite a good idea of the properties in which they may be interested — all in the comfort of the agent's office and in much less time

than it takes to traipse around them all with a salesman. Customers can inspect those properties of interest they've selected from the video tape.

Bigge and Little are rapidly building up a tape 'library' of the properties on their books.

An added bonus is reduced costs. Bigge and Little have been able to reduce commissions by a third as there is a considerable reduction in vehicle overheads and wasted journeys.

Meanwhile, the video boom is spreading amongst real estate agents. Since getting this story, we have been told of two other Sydney estate agents who have followed Bigge and Little's lead and another in Melbourne. Seems a fascinating phase of real estate salesmanship has been launched ...

## Hailing Halley's comet

This month's feature is concerned, amongst other things, with cometary exploration as Halley's comet will re-appear in our solar system in 1985 and a number of countries are working on proposals to rendezvous a satellite with the comet.

The British Aerospace Dynamics Group (under contract to the European Space Agency) has recently completed a study of the possibility of

intercepting Halley's comet using a satellite called GIOTTO.

It has been given this name after the Florentine master Giotto di Bondone who de-

picted the appearance of this comet in 1301 in his painting **Adoration of the Magi** which he probably completed in 1304 — the earliest known visual impression of this comet.

The three month study undertaken in England assessed the feasibility of a mission using a satellite based upon the highly successful GEOS-1 and -2 design (ETI October 1978). It is intended to intercept the comet with an instrument-laden satellite which will provide data on the chemical composition of the coma region surrounding the nucleus and tail of the comet. A camera will return images of the nucleus and measurements will also be made of its magnetic field. In this work the satellite must pass less than 1000 km from the nucleus of the comet which may be only a few km in diameter.

The time available for observation is only a few hours, so extreme accuracy is required in computing the orbits of the comet and of the satellite. The European Space Agency plans

to use the Space Telescope (see ETI, June 1980) to track the comet during its approach to the Sun to provide the data needed to direct the Giotto satellite to the encounter point.

The satellite will carry a solid propellant rocket motor for injection into the orbit to intercept the comet together with a very advanced telecommunications system for the transmission of the data back to earth over a distance of some 160 million km. A shield will protect the satellite from destruction by the particles in the tail of the comet which approach at over 80 km per second.

The cost has been estimated at 50 million pounds, but European scientists, like the Americans, feel that this opportunity for studying a comet at close quarters must not be lost. The project should enable a resolution of items in the nucleus of only a few metres to be obtained and we shall not be able to view this most famous of all comets again for 75 years.

## Snakes alight! It's the Starchaser!

A Sydney company is now making a sequence chaser to control four channels of snakelights or other lamps.

'Snakelights', popular in discos, are long flexible plastic tubes that look like garden hose till you plug them in. Then they light up with coloured lamps all along their length that can flash on and off in an extraordinary variety of combinations.

The Saturn 4 Starchaser from Sevlén Lighting has an 'autochase' mode that runs snakelights simply as light chasers at speeds varying from one change every seven seconds to thirty changes a second, but for really elaborate effects the machine should be used in its 'audio level' mode. This modulates the light sequence according to the level of a sound

signal and used with the variable speed control gives a wide range of effects with intriguing names like **pumping, whizzing, bouncing and auto-reversing.**

Sevlén also make the snakelights themselves. They come in twelve colours and ten metre lengths that can be connected end to end to make a sinuous chain up to 300 metres long. A continuity link (claimed to be unique) ensures that the whole circuit still functions if one of the lamps fails.

More information from Sevlén Lighting Pty Ltd, 4 Weldon St, Burwood, NSW 2134. (02) 74-8905.



## New Mitsubishi VCR

The new Mitsubishi VCR, as featured on page 9 last issue, will be released in Australia shortly through AWA-Thorn.

Last month's item indicated that the machine has been available in other countries since May, but at press time we didn't know when it would be available here. A call from AWA-Thorn just before this issue went to press put us in the picture...er, pardon the pun. Enquiries to AWA-Thorn in your capital city.

## National all-band radio

The latest consumer radio from National Panasonic will give a standard of resolution previously only attained by professional equipment, according to National.

the FM band.

For consumer appeal there are facilities like pressbutton tuning — you press keys to light up the desired frequency on a liquid crystal display and the PLL circuit automatically tunes in. Once a station is found it can be stored in memory for instant tuning thereafter. Up to fifteen stations can be preset in this way and sequentially scanned for 1.5 seconds each so listeners can select the one they want. For those who like a bit more personal involvement, there's also a manual tuning facility.

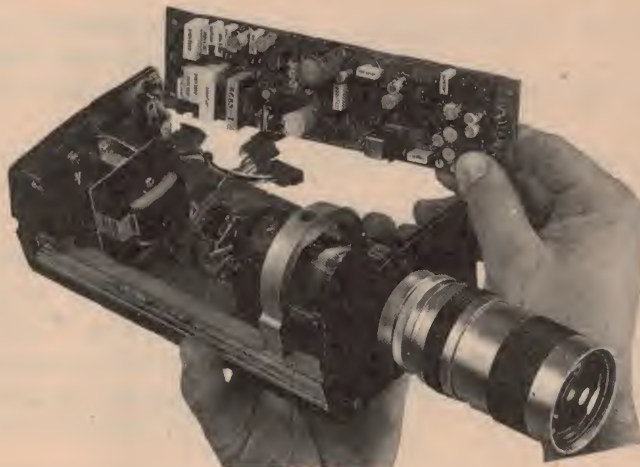
Microcomputer controlled programming allows six different preset schedules, with programme modes like automatic daily, once a week, every day but one, twice a week etc.

Price in this country is anticipated to be around \$3500. More details from National Panasonic (Australia) Pty. Ltd., 95-99 Epping Road, North Ryde, NSW 2113.



The RF-9000 has a phase-locked-loop synthesiser and double conversion super heterodyne circuitry which allows tuning in 100Hz steps on the long, medium and short wave bands and 10 kHz steps on

## Integrated CCTV



All the electronics for a new closed circuit TV camera are on a single printed circuit board.

The Spectar camera from Javelin Electronics achieves this by making use of medium scale integration (MSI) chips. Javelin say this is more efficient and reliable than unproven LSI technology.

The main pc board takes up only one side of the compact (approx. 200 x 110 x 70 mm) camera body, leaving space on the other side for boards incorporating special functions. Options available include Video Line Amp, which increases line output to match cable param-

eters in remote surveillance work, and an Inserter/Splitter which allows video from two separate sources to appear on the same monitor at the same time.

A standard feature is vertical phasing, which synchronises the signals of all the cameras in a system so that their vertical blanking periods occur simultaneously.

For more details contact Photo-Scan (A/Asia) Pty. Ltd., P.O. Box 588, Potts Point, NSW 2011. Phone (02) 33-0966.

## First optical undersea cable

The first submarine telephone cable ever to use optical fibres was laid recently at Loch Fyne in Scotland.

Conditions there are similar to the North Sea, where it is expected that the first commercial cable of this type will be commissioned.

Optical fibres offer a vastly greater bandwidth. This trial system, consisting of a 9.5 km loop, can carry 6000 telephone calls simultaneously, which is already 500 more than the largest conventional undersea cable.

Signal attenuation problems are dramatically reduced. To-

day's low-loss optical fibres can carry a signal 50 km before it needs to be amplified by a repeater station, whereas conventional cables need to incorporate repeaters every 5 km.

To cope with an expected doubling of international telephone calls every four or five years, the UK Post Office (who organised the Loch Fyne experiment) expect to have commercial optical cables available on short and medium routes by 1985 or 1986.

### ERRATA

For some perverse reason we've not yet been able to fathom, last month's Simple House Alarm project was numbered ETI-262. This project number has been used before — in December 1979, for the Simple Intercom.

The actual, originally issued, number that did not get onto the Simple House Alarm project, is ETI-250. All kit and component

suppliers have been notified. Printed circuit boards for the project are actually numbered ETI-250.

Also, in the ETI-564 Digital Clock featured last month, one tiny track came off the pc board artwork, between pin 5 of IC2 and pin 11 of IC3. The clock will work, but gains around four minutes a day without this connection as IC2 will divide by a little less than 3000. The circuit diagram is correct.



## 7 Segment Numeric and Dot Alphanumeric

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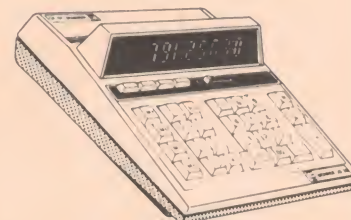


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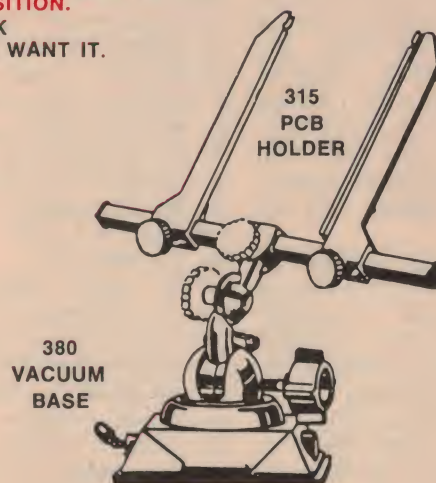
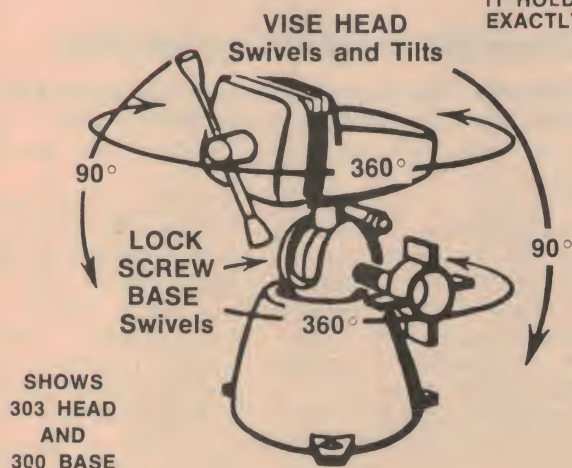
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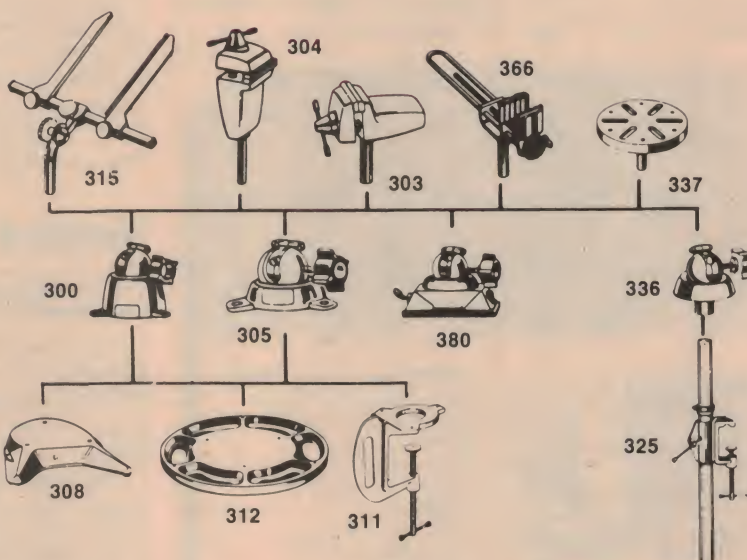
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## Saudi weather watch

An automatic weather and pollution monitoring network planned for Saudi Arabia will use METEOSAT, the European meteorological satellite, to relay data from outstations to a central processing centre.

There will be a total of 17 automatic monitoring stations distributed throughout the Kingdom. Seven synoptic weather stations will measure wind velocity, temperature, humidity and pressure of the air, total solar and ground radiation, hours of sunlight and UV radiation.

Six air quality stations will measure all the meteorological parameters and in addition provide data on levels of sulphur dioxide, nitrogen oxides, carbon monoxide and ozone.

Four marine outstations will each have a shore station to gather weather information as well as a remote buoy to measure wave heights and periods and the sea surface temperature.

Information from the

outstations will be stored for transmission to METEOSAT on a predetermined time schedule. METEOSAT will also transmit photographs in the visible, infrared and water vapour spectra to the central processing centre at Jeddah. Additional infrared and visible image data will be collected from the polar orbiting satellite TIROS-N.

The whole programme, which is believed to be the first of its kind in the world, is partly motivated by the Saudi government's desire to assess the environmental impact of their continuing large scale industrialisation plans. The major contractor is Plessey Radar of the UK, who are supplying a total of \$4.5 million worth of equipment — everything except the marine stations.



## Versatile frequency counter

**A 650 MHz frequency counter from CSC has selectable gate times and can be used with an external time base.**

The model 6001 benchtop counter has two front-panel BNC inputs, one for signals in the range 5 Hz to 100 MHz and the other for 50 MHz to over 650 MHz. The lower frequency input has a switchable low-pass filter which gives 3 dB per octave roll-off at 50 kHz for audio and ultrasonic measurements.

Gate times of 0.1 sec., 1 sec., or 10 sec. can be chosen, giving resolutions of 10 Hz, 1 Hz and 0.1 Hz respectively.

The internal timebase is a 10 MHz oven-controlled crystal oscillator, which is claimed to be accurate to within one part in two million from 0° C to 50° C, with a normal oven temperature of 55° C. A buffered output from this oscillator is available

through a rear panel BNC connector.

Another rear panel connector allows an external timebase to be used instead. If this has a frequency different from 10 MHz, the counter operates in a 'scaling' mode, in which the measured frequency is presented in different units. This enables the counter to be used as a direct indicating digital display in applications such as transducer translation, flow monitoring and tachometry.

The 6001 is mains powered, weighs 1.4 kg and measures 76 x 254 x 178 mm. More details from the distributors, Ampac Engineering Co. Pty. Ltd., 1 Wellington St, Rozelle, NSW 2039. Phone (02) 816-1168.

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5 great Oscilloscopes by Hitachi Denshi Ltd., Japan are now available in Australia from Standard Components. In addition to the V152 illustrated there are the V-151 15MHz single trace, V-301 30MHz single trace, V-302 30MHz dual trace and V-550 50MHz dual trace. Enquire about the great price and remember they are backed with good service and spare parts and are guaranteed for a full twelve months.

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## Vertical axis windmill

**An unorthodox design of windmill generator with vertical blades will be tested this month in Rocky Flats, Colorado.**

The makers, McDonnell Douglas, have christened it 'Giromill' and expect it to prove more efficient than normal types.

The prototype stands 37.5 metres tall with three blades 12.5 metres long supported by a 17 metre tower. It turns on automatically when the wind speed reaches about 18 km/h and runs free in high winds to prevent damage.

Designed to replace diesel and gas engines in isolated rural communities, the Giromill can be used to drive a generator to provide electricity for 15 homes or it may be geared down to run irrigation pumps for hundreds of acres of farmland. Installation and operating costs are expected to be lower than for horizontal axis mills.





## OPAL 1000

The OPAL 1000 is an 8 slot S-100 system conforming to the new IEEE standards. A Delta Products Z80a 4Mhz CPU card with 2 RS232c serial and 3x8 bit parallel ports is used in conjunction with the Delta Products Disk Controller. One serial and one parallel (Centronics interface) port have been initialised as printer ports. Memory is provided by a 4 MHZ 64k dynamic RAM Board by Measurement Systems and Control. The memory board is fully bank selectable and is designed for upgrading to a multi-user system. Disk drives are 2x8" Shugart SA801R running at double density (480k/disk) and fitted with our exclusive Disk Saver which prolongs the life of the drives and floppy disks by turning off the AC power to the drives 14 seconds after the last drive select and thus reduces routine maintenance. The Disk Saver also reduces the risk of data loss due to power failures. The system is mounted in an attractive pressed Aluminium housing with a cast front panel fitted with reset button and key operated on/off switch. The operating system software is CP/M version 2.2 with Delta Product's utilities which include DTEST (for testing drives and floppy disks) and M2 (a comprehensive memory test program). The Delta PROM monitor enables fault finding to be carried out independently of the Disk Drives.

**PRICE** .....\$4,174.00  
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## NDK S-4000 Wordprocessing Printer

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| D. Adjustable tractors.                | I. 6 month's warranty.                                |
| E. 2 x Form Control Loops & 2 Ribbons. |   |

Installation and servicing can be arranged through STC for any location in Victoria, New South Wales and The Australian Capital Territory. Other locations by negotiation.

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**Cable (for parallel interface only, see NDK S-2000 for types available)** .....\$50.00  
**Complete service manual** .....\$35.00

## SPECIFICATIONS

<b>Printing method:</b>	Dot Matrix impact. Serial printing by 16 wire head.			
<b>Printing direction:</b>	Bi-directional printing with logic seeking and 762 mm/second (max.) space skipping function.			
<b>Character Size, Pitch, Speed and Line Length:</b>				
<b>Character Mode</b>	<b>Regular Mode</b>	<b>Draft Mode</b>		
(Normal/Enlarged)	<b>Pica</b>	<b>Elite</b>	<b>Pica</b>	<b>Elite</b>
<b>Printing Speed (Char/sec)</b>	75/35	90/45	150/75	180/90
<b>Pitch (CPI)</b>	10/5	12/6	10/5	12/6
<b>Line length (char/line)</b>	136/68	163/81	136/68	163/81
<b>Dot density:</b>	4.7 dots per mm.			
<b>Character set:</b>	160 codes (JIS c6220, 8 bit). 2 modes (regular and draft).			
<b>Line Feed:</b>	6 lines per inch or 12 lines per inch. 45 lines/second (slew rate 6 lines per inch). 40 ms max. (single feed).			
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<b>MTBF:</b>	2000 hours.			
<b>Life:</b>	7 years (Head life: 100 million characters plus).			

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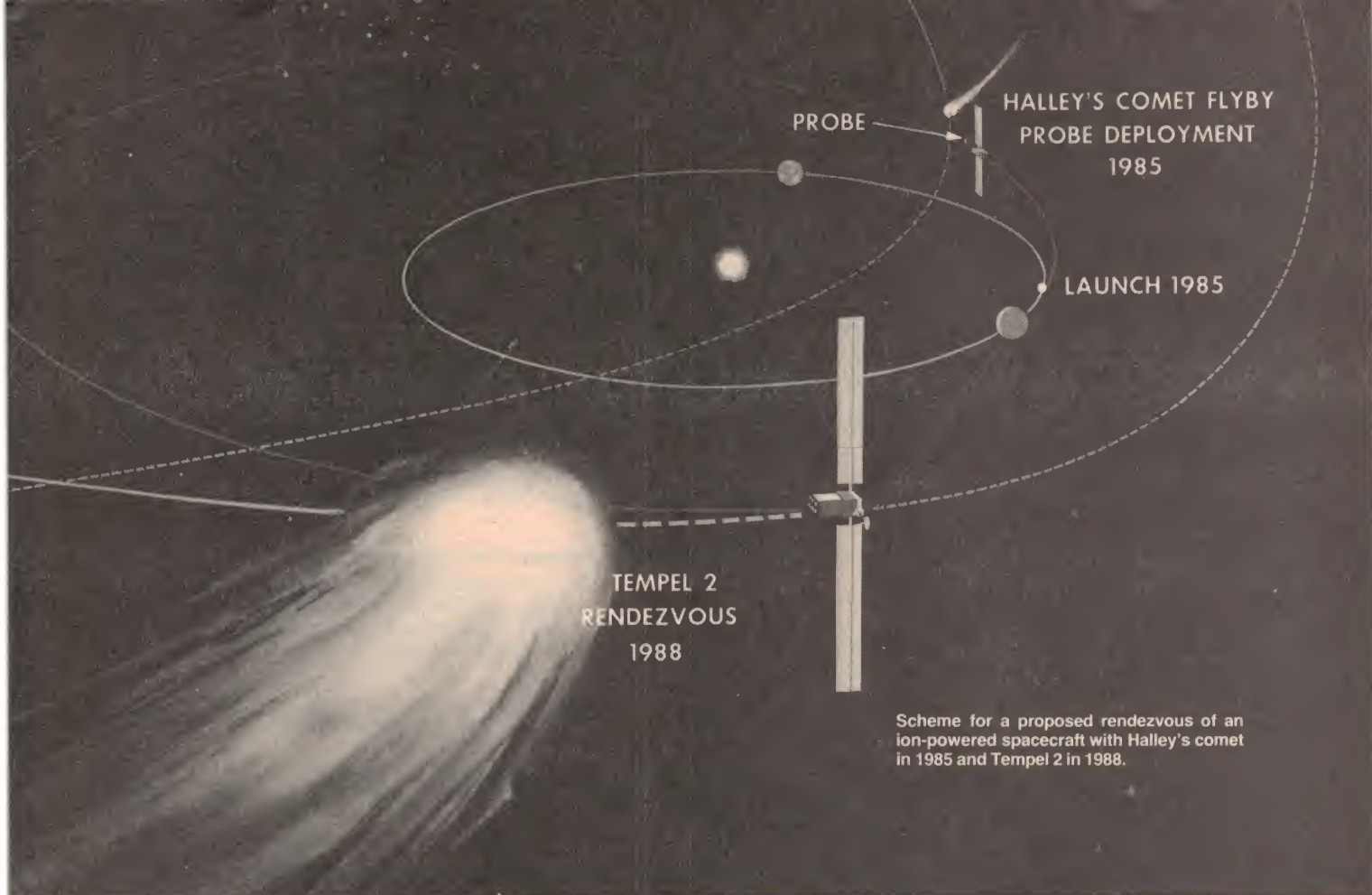
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# Solar electric propulsion and cometary exploration

This fascinating story tells how the power of the sun may be used with ion drive motors to take our spacecraft to much greater velocities than has yet been possible. Plans have even been made for such craft to chase comets.

**Brian Dance**

**CHEMICAL PROPELLANTS** have been used to power the rockets which have placed all our spacecraft into earth orbit, or into deeper space. Most of the rocket fuel is placed in the first stage of the rocket which boosts the second and later stages to a high velocity before the first stage is detached; the second stage boosts the much smaller mass to a higher velocity. After the second stage is exhausted, it too is detached and the third stage is fired so as to increase the velocity of the payload still further.

Unfortunately, the use of successive stages in this way means that a large

amount of fuel is used to lift a relatively small payload. The maximum weight of the payload which can be lifted into earth orbit is limited, but much more severe limitations occur when one wishes to send a payload into deep space. Multi-stage rockets are required to give a payload an adequate velocity to take it into deep space and the final stage of the rocket can carry only a relatively small payload if the size of the first stage is to be at all reasonable.

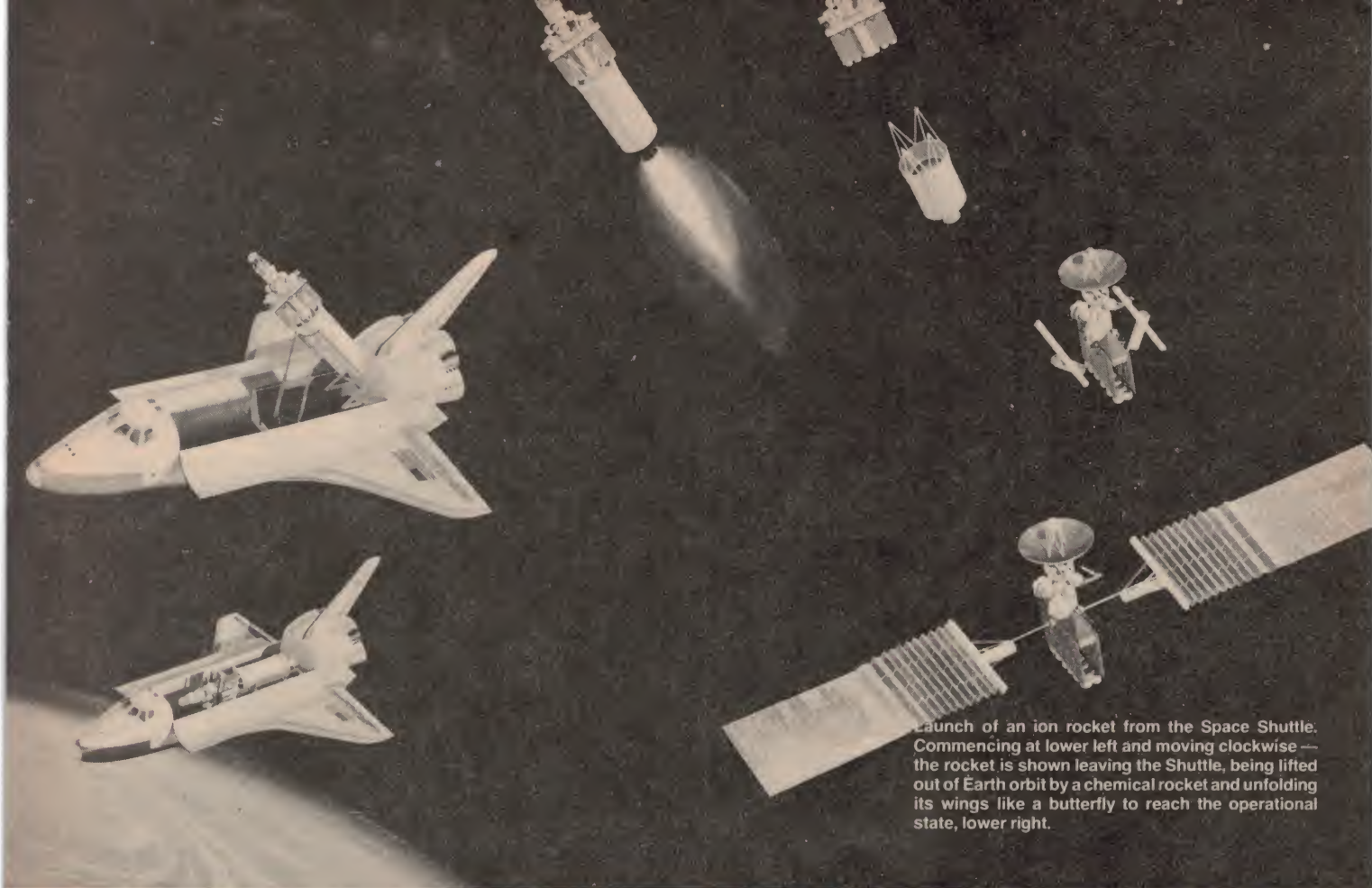
Once a rocket is on its way into deep space, its velocity cannot be changed by very large amounts unless it can be

directed near to some massive object such as Jupiter. Deep spacecraft carry only a relatively small amount of hydrazine fuel which can be catalytically decomposed into gases which are fed to jets to change the velocity of the craft slightly or to alter its speed of rotation.

## Ion drive

Scientists have proposed a new method of propelling spacecraft so that they can continuously accelerate over a long period using the power from the sun. Spacecraft using this method of





propulsion would still have to be lifted into the vacuum of space above the atmosphere of the earth by a rocket using a chemical propellant, but once there the spacecraft could be accelerated without any further use of chemical fuel. It is intended that spacecraft powered in this way will be able to chase rapidly moving objects, such as comets, and investigate these objects as they fly alongside them.

For this kind of work speeds of around 150 000 to 250 000 km per hour are required. However, the use of ion drive seems very attractive for any missions to Saturn and the other outer planets (especially if heavy payloads are to be carried) and for return journeys to some of the nearer planets, such as Mars.

The basic idea of the ion drive system is that electrical energy of sun light will be used to provide the power required to volatilise mercury and to ionise the atoms of the vapour which will then be accelerated by high voltages to tremendous speeds. The mercury ions will be ejected from the spacecraft at an enormous velocity so that the craft is pushed forward. When chemical propellants are employed, the burnt fuel is ejected from the rocket motors so as to propel the vehicle. The amount of fuel required is very large, since the velocity of emission of the burnt gases,

although high, is not nearly so high as designers would wish. In order to give a spacecraft a continuous acceleration over a long period, one would need a tremendous weight of chemical fuel and it is just not practicable to put such a weight in orbit.

The ion motor operates by using a much smaller weight of fuel, but obtains a reasonable thrust by ejecting the ions formed from that fuel at far higher velocities than is possible with the atoms of a normal chemical fuel. Although the force from ion motors is relatively small, the force can operate over very long periods (months or even years) so that the spacecraft velocity is boosted to a very high value over a prolonged period of time. Mercury atoms are used as the fuel for the ion motor, since mercury atoms are relatively heavy and are readily volatilised.

The concept of the ion motor bears a similar relationship to the rocket motor as the latter bears to a gun. In the case of a gun, the gases formed by an explosion of a chemical cartridge push on the bullet or other projectile only for the very short time the projectile is passing down the muzzle. The propellant does not move with the projectile. In the case of rocket motors, the unused fuel moves with the projectile so that the rocket can

be accelerated over a much longer period than the time of acceleration of a bullet from a gun. In the ion motor the period of acceleration is extended still further from the few minutes of a typical rocket by a very large factor.

## Ion Motors

In the USA a whole team of scientists and engineers are working on ion motors. The study team is headed by people from the Jet Propulsion Laboratory of the California Institute of Technology and includes workers from NASA's Lewis Research Centre, Cleveland, Ohio and the Marshall Space Flight Centre, Huntsville, Alabama. They are working on the integration of light-weight solar arrays and mercury ion engines for a workhorse shuttle spacecraft for the next two decades.

An ion powered spacecraft will be a really impressive sight, since it will have solar panel arms about 150 metres across when fully extended resembling a huge galactic butterfly in space. The solar panels in these arms will be able to develop a power of the order of 100 kW from sun light. The electrical energy from the solar array will be converted by a power conditioning unit into the voltages required to operate the ion motors.



It is planned that each spacecraft will have about ten ion engines of which eight will operate at any time and two will be spares. Each engine will be in the shape of a coffee-can about 28 cm in diameter and about 27 cm in depth. The fuel will be liquid mercury.

The main part of an ion motor is the ionisation chamber in which the mercury atoms are converted into charged ions by collision with electrons. The ions are focused by electric and magnetic fields and delivered to a pair of accelerating electrode grids.

These ions are then expelled from the spacecraft at a very high velocity indeed. An ion motor does not produce any explosion or anything like the white hot gases from a conventional rocket engine. There is merely a steady, flameless violet glowing beam of high energy particles which push the rocket steadily in the opposite direction to their motion.

Early versions of the engines being developed for ion drive were placed in earth orbit as early as 1969 during the Space Electric Rocket Test (SERT) Programme under the direction of the NASA Lewis Research Centre. These experimental engines gave much valuable information on ion drive and were operating for over seven years in space.

## Techniques

Although electricity-producing solar arrays have been used in most spacecraft for power production,

spacecraft using ion drive propulsion will require solar power on a far greater scale than any vehicles launched previously. In order to keep the launch weight to a reasonable value, ultra-light weight solar cells only 50 micrometres in thickness have been developed.

The enormous size of the solar cell arrays required for powering the ion drive motors of a spacecraft makes it essential that these arrays should be folded up into a small space at launch. In the unfolded state they could not possibly be fitted into any launching rocket of a size we may be able to make in the foreseeable future. New methods of stowing deployment for the launching phase have therefore been developed which will enable the spacecraft solar arrays to be deployed in earth orbit almost like roll-down window shades!

Once the system has been lifted into space, probably by the Space Shuttle, the flexible thin blankets of solar cells tightly wrapped around a central core will be unrolled in the ion drive spacecraft to begin to provide the power required. The ion motors will then commence to operate (they are not ignited like a conventional rocket) and the ion powered drive to distant targets will commence.

The ionisation propulsion technique is said to promise fuel economies over ten times better than the conventional chemical rockets of today. Projects which we have only been able to dream about in the past because of the high

cost of rocket fuel and rockets are expected to fall easily within the reach of the ion propelled spacecraft.

## Work on comets

One of the most interesting pieces of work for ion powered spacecraft is the investigation of comets. Some comets travel in elliptical orbits around the Sun with their major axis much greater than their minor axis. When near the Sun, they travel much faster than when in deep space and this inevitably means that such comets spend most of their time in deep space at huge distances away from us. Other comets come into the vicinity of the earth from deep space and then return to deep space, never to return to the vicinity of the earth.

In order to investigate such fast moving objects in the short time they are near to us, very high velocity spacecraft are required. Ion powered spacecraft would seem ideal for this purpose. The comets Encke and Giacobini-Zinner have been considered as possible targets for ion powered spacecraft, but perhaps the most interesting of all comets is the famous Halley's comet which will make its closest approach to the earth in 1986. It visits our region of space only about once every 76 years, so we shall have to wait a long time if we do not take this opportunity of investigating it in 1986.

The object is of particular interest, since it has such a long and interesting history. Halley himself observed it in 1682 and recognised that it was the same object that Kepler had seen in 1607 and Apian in 1531. Halley's comet returned again and was seen by an amateur astronomer, Palitzsch, on Christmas night 1758, reaching its closest approach to the Sun on 12th March 1759. In 1835 it was found by Domouchel and later developed into a brilliant naked eye object with a tail some 25° in length (corresponding to a diameter about fifty times that of the moon!) as seen from the earth. It was again seen in 1910 and formed a magnificent view in the Southern hemisphere. It has been possible to trace this comet back as far as the year 11 BC, the intervals between its returns being from 74 to 79 years, the period depending somewhat on the gravitational influences of objects such as Jupiter and Saturn on the orbit of the comet. It was often considered as a heavenly sign of historical events, one of the most interesting being its appearance in April 1066 when the success of William the Conqueror was attributed to its presence.

Detailed plans have been made to employ an ion drive spacecraft for launch in 1982 to reach the vicinity of

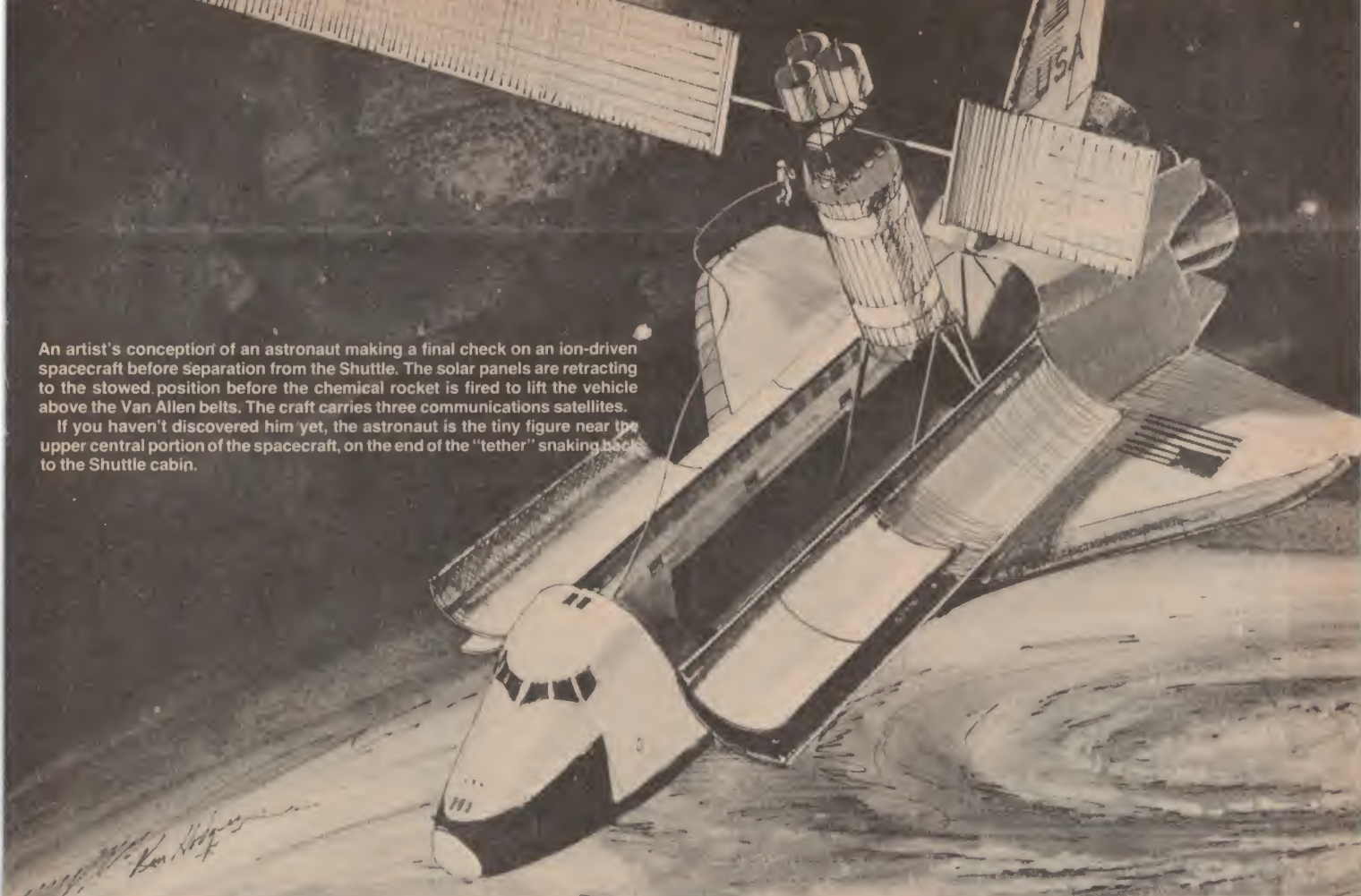
Artist's conception of an ion-powered craft rendezvous with Halley's comet.





An artist's conception of an astronaut making a final check on an ion-driven spacecraft before separation from the Shuttle. The solar panels are retracting to the stowed position before the chemical rocket is fired to lift the vehicle above the Van Allen belts. The craft carries three communications satellites.

If you haven't discovered him yet, the astronaut is the tiny figure near the upper central portion of the spacecraft, on the end of the "tether" snaking back to the Shuttle cabin.



this comet about three-and-a-half years later. The spacecraft would fly alongside the comet and put a probe with scientific instruments into the nucleus of this famous comet. Scientific data would be returned to the earth by telemetry from a distance of about 93 million miles and the spacecraft would then continue to a rendezvous with the comet Tempel 2 in 1988.

Unfortunately it seems very doubtful whether his magnificently planned project will be carried out. Budgetary considerations in NASA have delayed

work on the ion propulsion system and the latter must get into top gear by the end of 1980 if the Halley and Tempel 2 comet encounters are to become a reality.

The latest information from the Jet Propulsion Laboratory is that it is planned to send a spacecraft to Halley's comet using only conventional rocket power. It is intended that a probe will be sent into the comet, but the available power will not be adequate to fly alongside the comet in formation nor to visit the second comet Tempel 2.

Although a much less exotic mission than the one planned using ion propulsion it should provide much valuable data on a fascinating and historical object.

It is understood that the Russians, Europeans and Japanese also have plans to send missions to a rendezvous with the Halley comet.

In spite of the disappointment over the almost certain cancellation of the ion drive mission to Halley and Tempel 2, ion drive propulsion will come in due course. Over a decade ago solar electrical developmental work by NASA resulted in the choice of ion drive over the solar sail concept for long term, space flight propulsion to distant regions of the solar system when heavy payloads are involved.

Thus it seems we must be very patient for the time being and wait until ion drive can accomplish the huge fascinating tasks awaiting it in the future.

### Acknowledgement

The writer would like to express his gratitude to Mr. Don Bane, Public Information Office, Jet Propulsion Laboratory, California Institute of Technology for the information and artwork he has kindly provided for us in this article.

**TABLE 1. Typical Data on an Ion Drive System.**

**Fuel:** 500 kg to 1000 kg of liquid mercury (amount depends on the mission).

**Engine size:** 28 cm diameter by 27 cm deep.

**Thrust force, per ion motor:** 0.25 Newton.

**Total thrust force (eight engines):** 2 Newton.

**Exhaust ion velocity:** 30 to 50 km per second (67 000 to 112 000 miles per hour).

**Specific impulse:** 3000 to 5000 second.

**Solar power generated:** 50 to 100 kW.

**Proposed solar array plan-form:** 8 x 75 metres per solar panel wing.

**Approximate average spacecraft acceleration:** 86 metres per second per day or 190 miles per hour per day.

**Estimated typical spacecraft speeds relative to the earth:**

after 100 days of ion thrust 55 000 miles per hour

after 500 days of ion thrust 131 000 miles per hour

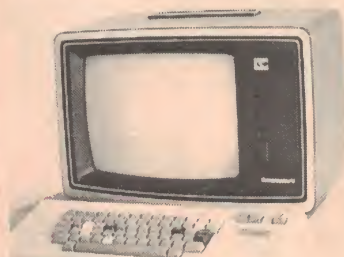
after 1000 days of ion thrust 226 000 miles per hour.

**Typical initial escape speed:** 36 000 miles per hour.



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104.1	2DAY	Soft rock aimed at the 25-40 age group.
104.9	2MMM	Contemporary rock aimed at the 18-30 age group.
105.7	2JJJ	Way out music and talk similar to 2JJ-AM.
107.5	2SER	Educational and community programs.

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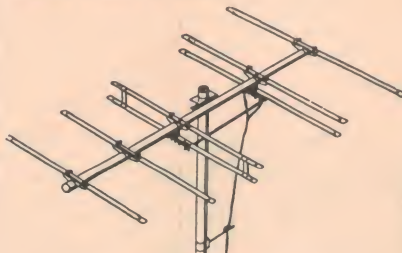
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# AM Tuner features wide bandwidth and low distortion

**Design: Ken Woods**  
**Article: Staff**

Now the 'FM boom' has arrived, the AM stations are fighting back with wide bandwidth, good quality sound. This tuner, though simple to build and get going, provides extraordinarily good performance.

WE WERE SURPRISED to learn recently that many of the AM broadcast stations have been transmitting 'full bandwidth' signals for quite some time, it seems they're 'fighting back' at the recent boom in FM with all the new stations coming on to the VHF band.

This tuner has been designed to take advantage of this situation. Broadcast stations are permitted to transmit an audio bandwidth that rolls off at 15 kHz. That means an AM broadcast station will have a nominal bandwidth of 30 kHz. At first glance this seems a little out of kilter as frequency spacing in the 530 - 1650 kHz AM broadcast band is 9 kHz. However, stations serving a particular area are generally allocated frequencies no closer than 54 kHz. Hence, a wideband tuner may be used to exploit the good quality reception possible from stations transmitting 'full bandwidth' programme material.

## Design

The designer, Ken Woods, has chosen to employ a 'tuned radio frequency' design to achieve low intermodulation distortion, low phase distortion and good transient response. There are only two tuned circuits. The overall selectivity is determined solely at the front end, at the frequency selected. The parameters of the input double-tuned circuit have been arranged to provide the required bandpass selectivity with good attenuation outside the passband, to reduce unwanted noise and interference. This circuit arrangement provides low phase distortion as it has a slowly varying phase change across the pass band and no phase reversals. Transient response of this particular arrangement is also good as there is minimum signal delay from input to output and the Q has been carefully 'tailored' to reduce the 'fly-



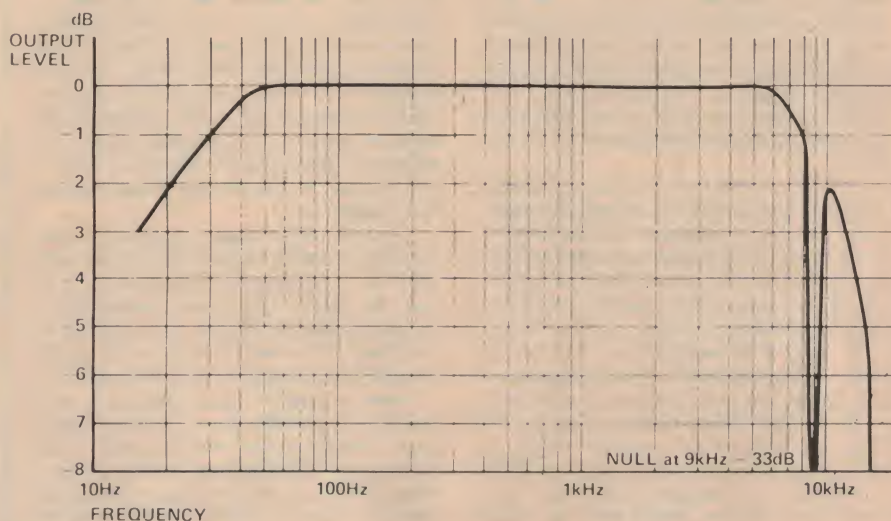
The tuner is housed in a simple, yet attractive, case. A plugpack is used to power the unit.

wheel effect' of multiple tuned circuits (ringing).

In addition, the circuit has a virtually constant bandwidth characteristic right across its tuning range. It's a little too complex to go into here, but readers looking for a good reference could hardly do better than consult "The Radiotron Designer's Handbook", by F. Langford-Smith, published by AWW-RCA,

Chapter 8, section (iii) 'Complex Coupling' (Page 420 in ours, the Fourth Edition).

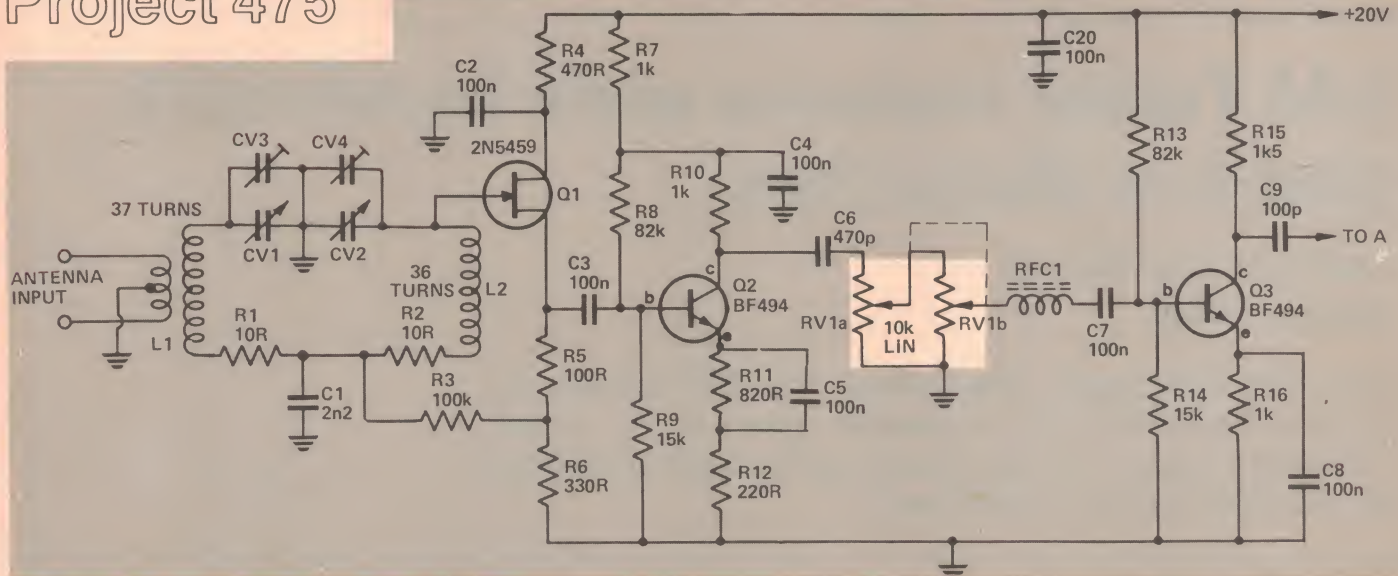
The tuner has a manual RF gain control and no AGC so that the evil of AGC distortion, prevalent with conventional superhet AM tuners, is eliminated. Actually, rather than varying the gain of one or more of the amplification stages, the RF gain control is an attenuator, ▶



Overall frequency response of the receiver. The response is 3 dB down at 15 Hz and 12 kHz. The whistle filter provides 33 dB of attenuation at 9 kHz and is 3 dB below midband response at just over 8 kHz and just below 10 kHz.



# Project 475



## HOW IT WORKS — ETI 475

The tuner employs a TRF design where all the amplification and selectivity is achieved at the actual frequency of reception, prior to the detector.

The required selectivity characteristics are provided by the input tuned circuit which is arranged to tune the whole broadcast band, from 530 kHz to 1650 kHz. Several stages of untuned RF amplification follow the tuned circuit. A low distortion diode detector removes the audio programme information from the selected station's RF carrier and this is fed to a 9 kHz whistle filter — which provides a deep 'notch' to remove interstation heterodynes — followed by an audio output stage.

For best, low noise reception, a balanced antenna input is provided. Antennas are discussed in the text. The two tuned circuits, comprising L1, L2 and the dual-gang tuning capacitor CV1/2, are mutually coupled by C1. Individually, each tuned circuit has quite a high Q by virtue of the totally 'closed' magnetic field provided by the pot core. The reactance of C1, whilst small, is sufficient to overcouple the two tuned circuits, providing a 'double-humped' response (see the accompanying diagram). To remove the 'dip' in the middle of the response, the overall circuit Q is 'damped' by two, low value resistors — R1 and R2.

A FET source follower, Q1, isolates the input tuned circuits from the first RF amplifier stage, Q2. The input impedance to the gate of Q1 is quite high and this avoids loading the coupled tuned circuits which would reduce the Q. Gate bias dc return is via R3, R2 and L2. The source of Q1 is coupled to the base of Q2 via C3. This first stage of RF amplification has a gain of about five and is stabilised by having part of the emitter bias resistance unbypassed (R12).

An RF gain control is placed between the first and second RF amplifier stages. A dual-gang potentiometer, RV1a and RV1b, connected in a cascade configuration, provides very smooth control over the signal level.

The input stage FET has its drain decoupled

from the supply rail by R4 and C2 while Q2 has its collector circuit and base bias decoupled by R7 and C4.

The third stage of amplification is provided by Q3 which operates at full gain. To prevent VHF parasitic oscillation in this amplifier, a wideband RF choke, RFC1, has been inserted in series with the input to the base.

A further two stages of amplification follow, before the detector. Transistors Q4 and Q5 are direct-coupled and the collector of Q5 drives the diode detector via C11.

The detector is a voltage-doubling type with degeneration to reduce distortion. In addition, there is negative feedback from the detector to the emitter of Q4 via C12, further reducing distortion. A signal strength meter has been provided as a tuning aid. It measures the dc output level from the detector. Capacitor C14 provides smoothing for the meter, removing any audio signal influence.

RF 'smoothing' from the output of the detector is provided by R24 and C15 forming a low pass filter that passes audio (3 dB down at 28 kHz) but bypasses the RF. The output of this is coupled to the input of the audio output stage via the 9 kHz whistle filter. This is a parallel tuned circuit made up by L3 and C16. This provides a 'notch' in the audio response, attenuating any 9 kHz interstation whistles by more than 30 dB. The coil is constructed in a pot core which ensures high Q and a narrow bandwidth notch.

The audio output stage consists of a Darlington pair emitter follower stage, Q6 and Q7. This has a high impedance input, so as not to load the whistle filter, and a low impedance output suitable to drive the 'tuner' input of an amplifier. The collectors of Q6 and Q7 are decoupled from the supply rail by R29 and C18.

Power is supplied from a plug back, thus removing a possible source of hum pickup, and a voltage-doubler rectifier involving D3, D4, C21 and C22. Extra supply filtering is provided by R31 and C23. A front panel LED power indicator, LED1, is supplied directly from the rectifier output. Switch SW1 is used to turn the tuner on and off.

located between the first and second stages of RF amplification. Its purpose is to allow adjustment of the signal level so that at no time is the detector overloaded.

The detector employed features some signal degeneration, via R23, to reduce distortion and negative feedback to one of the RF amplifier stages to further reduce distortion. The overall distortion

## PARTS LIST — ETI 475

### Resistors

	all ½W, 5%
R1, R2	10R
R3	100k
R4	470R
R5	100R
R6, R21	330R
R7, 10, 16, 20	1k
R8, 13, 17	82k
R9, 14, 18	15k
R11	820R
R12	220R
R15, 19, 22, 25	1k5
R23	56R
R24	4k7
R26	270k
R27	4M7
R28	5M6
R29	12k
R30	2k2
R31	270R

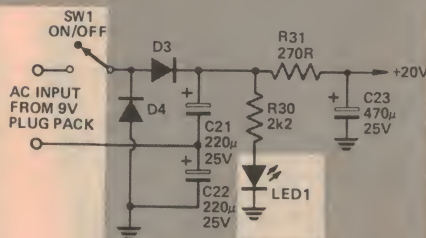
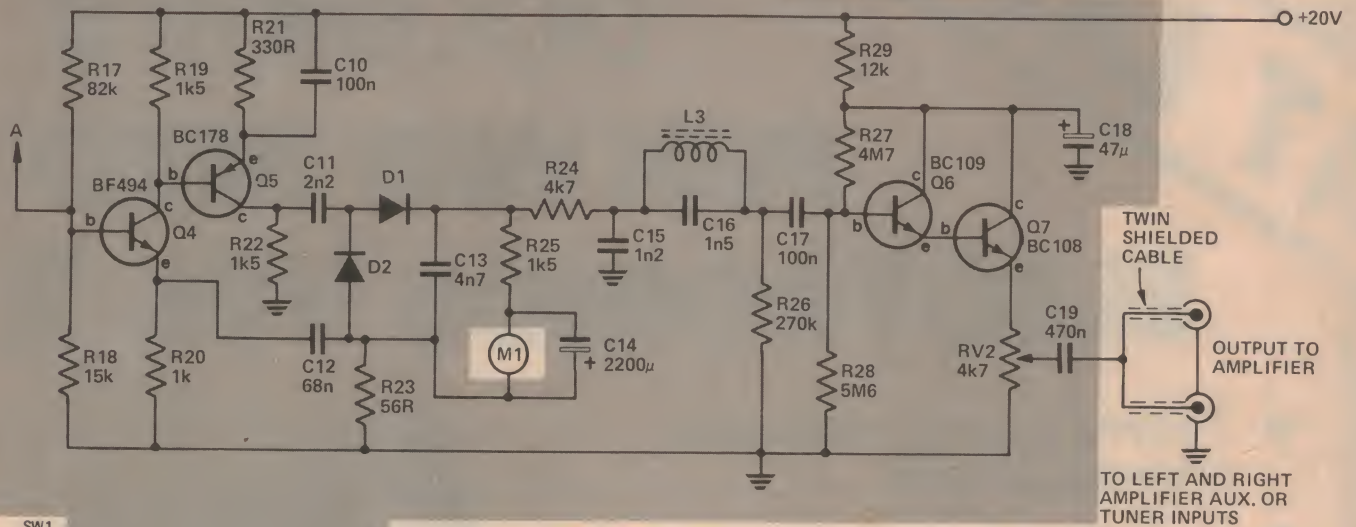
### Potentiometers

RV1	10k linear dual pot.
RV2	4k7 flat mounting large trimpot.

### Capacitors

C1, C11	2n2 greencap
C2, 3, 4, 5, 7,	
8, 10, 17, 20	100n greencap
C6	470p ceramic or styrofoam
C9	100p ceramic or styrofoam
C12	68n greencap
C13	4n7 greencap
C14	2200u/16V electro
C15	1n2 greencap
C16	1n5 see text
C18	47u/25V electro, axial lead type





C19 ..... 470n greencap  
C21,C22 ..... 220u/25V electro  
C23 ..... 470u/25V electro

## Variable Capacitors

CV1,CV2 ..... 415p dual gang variable capacitor (Roblyn RMG — 2), see text  
CV3,CV4 ..... 40p film dielectric trimmer, Philips type 2222 808 01027 (grey case) or similar.  
Inductors ..... see coil winding details

## Semiconductors

D1,D2 ..... AA119, OA95, see text  
D3,D4 ..... 1N4004, A14A or sim.  
Q1 ..... 2N5459  
Q2-Q4 ..... BF494  
Q5 ..... BC558, BC178  
Q6 ..... BC549, BC109  
Q7 ..... BC548, BC108  
LED1 ..... red LED, TIL220R or sim.

## Miscellaneous

SW1 ..... one pole, two position rotary switch  
M1 ..... 1 mA meter, University TD48, Minipa MU45 or similar

Planetary dial drive with flange (Watkin Wynne type 4511 DAF or similar); large black knob 40 mm dia., aluminium disc 55 mm dia. for scale plate (see text); two small black knobs; two antenna terminals: one black, one red; two-pin plug and socket for power input; 9V plug pack, Ferguson type PPA9 - 500 or similar; length of twin shielded cable with two RCA plugs on one end; five pc board standoffs, box to suit (see text); ETI-475 pc board.

of this tuner proved to be significantly lower than that of our Wavetek laboratory signal generator, so we are unable to present a reliable distortion measurement. Listening tests confirm the low distortion characteristic of this tuner.

As some interference may be experienced in particular areas from distant stations propagating via the ionosphere (this generally occurs at night), a 9 kHz whistle filter has been incorporated. It provides an attenuation in excess of 30 dB at 9 kHz and the notch bandwidth is about 2 kHz maximum. If you do not experience any difficulties with this sort of interference, the whistle filter may be dispensed with.

A tuning or signal strength meter has been provided and it has several functions:

- To provide a positive tuning indication.
- To facilitate optimum signal strength control.
- To indicate when signal overload occurs.

It's a very handy aid when adjusting antennas or when setting the RF gain control.

Instruments are not absolutely necessary to align the tuner, although a signal generator makes it somewhat quicker.

An inexpensive plug back is used to provide power to the tuner. This has the advantage of removing the transformer from the tuner's chassis, eliminating a possible source of hum.

## Construction

The tuner is housed in a chassis made from a 240 x 290 mm sheet of 16 gauge aluminium bent into a U-shape measuring 290 mm wide by 180 mm deep and

80 mm high. The lid was made from a 205 x 455 mm sheet of 16 gauge aluminium. It is bent and mounted so that it overhangs the front panel of the chassis by 10 mm and the rear by 15 mm. This results in quite a neat, professional-looking unit.

The power switch, power LED, signal strength meter, gain control potentiometer and planetary reduction drive are all mounted on the front panel. The antenna terminals and two-pin power input socket are mounted on the rear panel. The output lead passes through a rubber grommet.

Commence by marking out and drilling the holes in the chassis. This is probably best done before bending it up. Mark out accurately, as per the metalwork drawings. The size of hole required for the meter depends on the meter used. The one on our prototype is a Minipa MU-45 type. It fits neatly on the front panel and has a pleasing appearance. However, other types may be used, such as the University type TD48. This is a little smaller than our meter, but will do equally well.

Two lengths of aluminium angle are bolted to each side of the chassis and the lid is secured to these with either bolts (which mate with tapped holes in the angle pieces) or self-tapping screws. The aluminium brackets are cut from a single 320 mm length of 13 mm (½") angle. This is readily obtainable in hardware stores. Mark and drill the lid, then bend it carefully to shape. The aluminium angle pieces are best marked up and drilled using the chassis, and then the lid, as a template.

At this stage, the chassis and lid could be sprayed matt black inside and out, or anodised — if you're willing to go to that expense.



**AT LAST!**

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# DICK SMITH ELECTRONICS



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# Project 475

## COIL DETAILS ETI-475

### L1

Primary: two turns wound bifilar with thin plastic insulated hookup wire (wound last).

Secondary: 37 turns pile wound, 34 SWG enamelled wire (wound first).

### L2

36 turns, 34 SWG enamelled wire.

L1 and L2 are wound on Philips P18/11 pot core assemblies, 3D3 material,  $u_e = 68$ , with adjusters.

#### Philips part numbers

Pot core	4322/022/24450
Adjuster	4322/021/32170
Former	4322/021/30270
Washer	1811/HWI
Clip	1811/HPC

### L3

540 turns, 34SWG enamelled wire.

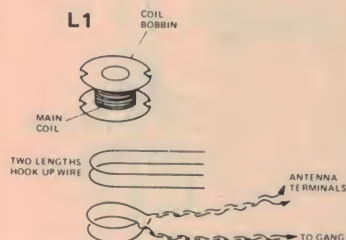
L3 is wound on Philips P26/16 pot core assemblies, 3B7 material  $u_e = 220$ , with an adjuster.

#### Philips part numbers

Pot core	4322/022/28080
Adjuster	4322/021/30810
Former	4322/021/30330
Clip	2616/HPC

No washer is used with the large pot core.

### L1

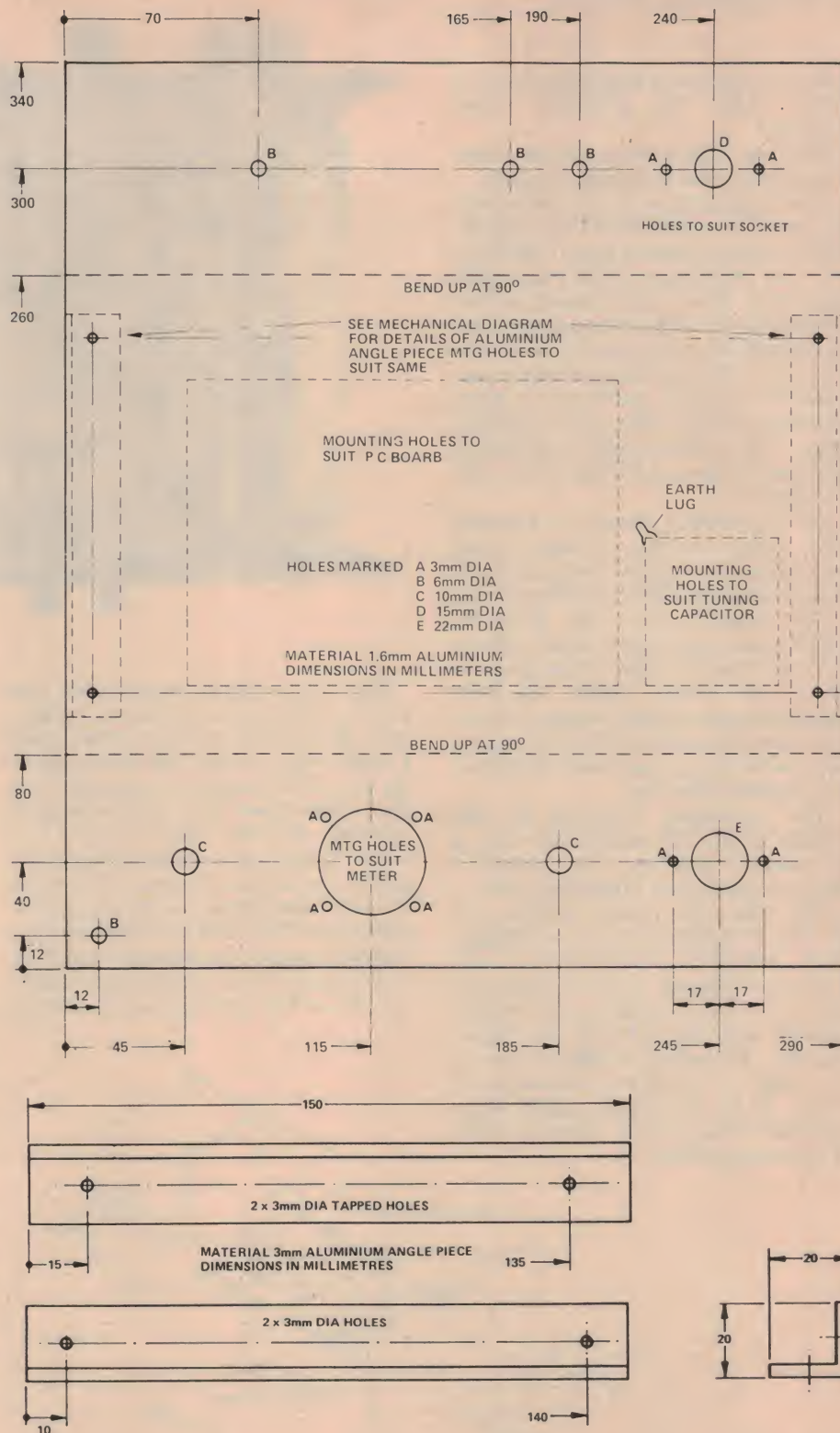


When the chassis is completely prepared, the major components can be mounted on it. The planetary drive should be mounted first. It is best to mount it on adjustable standoff pillars, as shown in the photographs, to allow the position of the dial flange to be adjusted. This should protrude from the front panel about one or two millimetres.

The dial was made up from a disc of 18 gauge aluminium (though 16 gauge or even a thinner gauge would be OK). The local stations were marked on the dial with white rub-down lettering (such as Letraset or Geotype). This disc is attached to the planetary dial flange by two screws supplied with the dial drive. The complete assembly is shown in the exploded-view diagram.

Since it will probably be difficult for most readers to cut a clean circle from aluminium, without the facilities of a machine shop, we have reproduced a suitable dial from which a Scotchcal copy may be made. If you use the metal Scotchcal, you can leave the backing paper on it and attach that as your dial.

The tuning knob on the prototype is a



little special. It consists of a large diameter knob with a turned-up aluminium 'cup' pushed over it (the inside diameter forms a snug fit to the knob). We'll leave the knob to your ingenuity. A large knob is recommended as it provides smooth control of the tuning, a good grip and enhances the appearance.

The next step is to mount the tuning gang. It is very important that no strain is placed on the planetary drive from the shaft of the tuning gang. Careful, correct alignment will ensure this. The tuning capacitor is mounted on small standoff nuts and the shaft is carefully aligned, using washers or something ►



# Project 475

similar, to pack the standoffs so that it mates with the planetary drive properly.

The rest of the chassis-mounted components may now be secured in place.

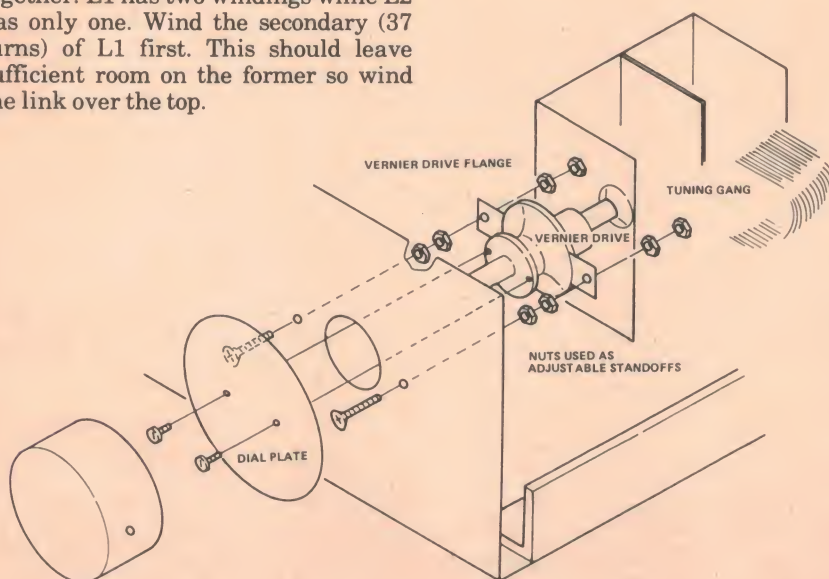
Assembling the pc board comes next. Mount all the components with the exception of the three pot cores. Take care with the orientation of the electrolytic capacitors, diodes and transistors. The BF494 transistors have an unusual lead configuration — the emitter lead is in the centre. When soldering the trimmer capacitors in place, don't use too much heat or strain the leads while soldering them. This avoids possible distortion of the plastic case and problems when adjusting them.

All components should be mounted right down on the pc board using minimum lead length. The transistors should have leads no longer than 5 mm.

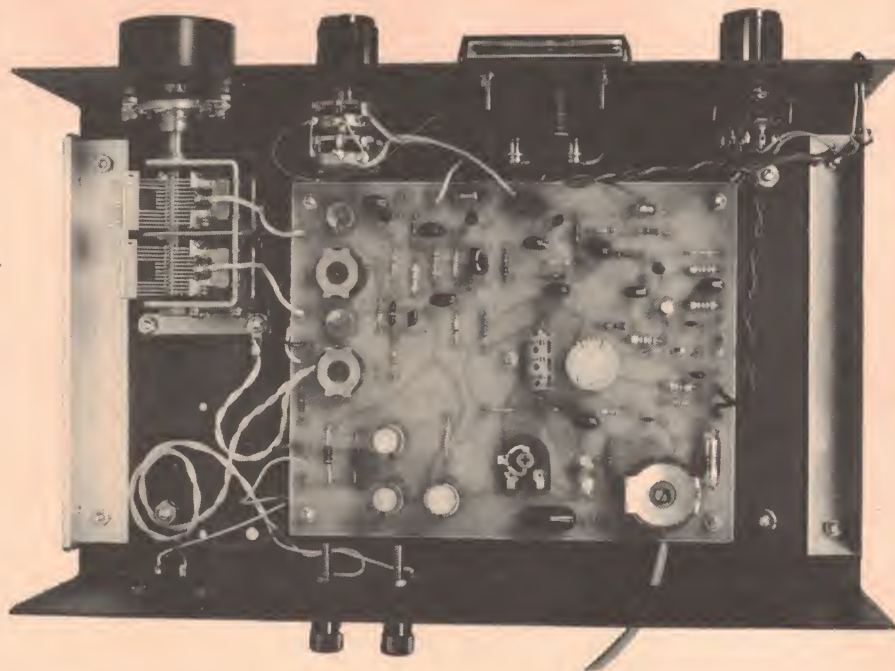
The detector diodes can either be gold-bonded germanium types like the AA119s recommended, or germanium types such as the OA47. The gold-bonded diodes will give lower detector distortion but may be difficult to obtain. We tried both types and could not detect any audible difference.

The resonating capacitor for the whistle filter, C16, should be either a styroseal or mica type to avoid drift in the tuning as this is a high-Q circuit.

The two input tuned circuits use 18 mm diameter pot core assemblies. Each assembly contains two ferrite halves, an adjuster, former, washer and clip. When assembled, the clip solders into the pc board and holds everything together. L1 has two windings while L2 has only one. Wind the secondary (37 turns) of L1 first. This should leave sufficient room on the former so wind the link over the top.

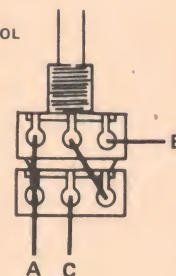


EXPLODED DIAGRAM OF VERNIER DRIVE AND DIAL ASSEMBLY



The link is bifilar wound with two lengths of thin, plastic insulated hookup wire. With the two wires parallel, wind a single turn around the former, over the top of the secondary winding. The start lead of one wire is then twisted together with the finish lead of the other. These two leads are twisted together for 150 mm or so and will connect to the antenna terminals after the coil is assembled. The other two leads are also twisted together, for 100 mm or so, and will be joined and soldered to an earth lug under the tuning gang mounting

RF GAIN CONTROL CONNECTIONS



bolt adjacent to the coil locations on the pc board.

The accompanying exploded diagram should make the assembly of this link winding clear.

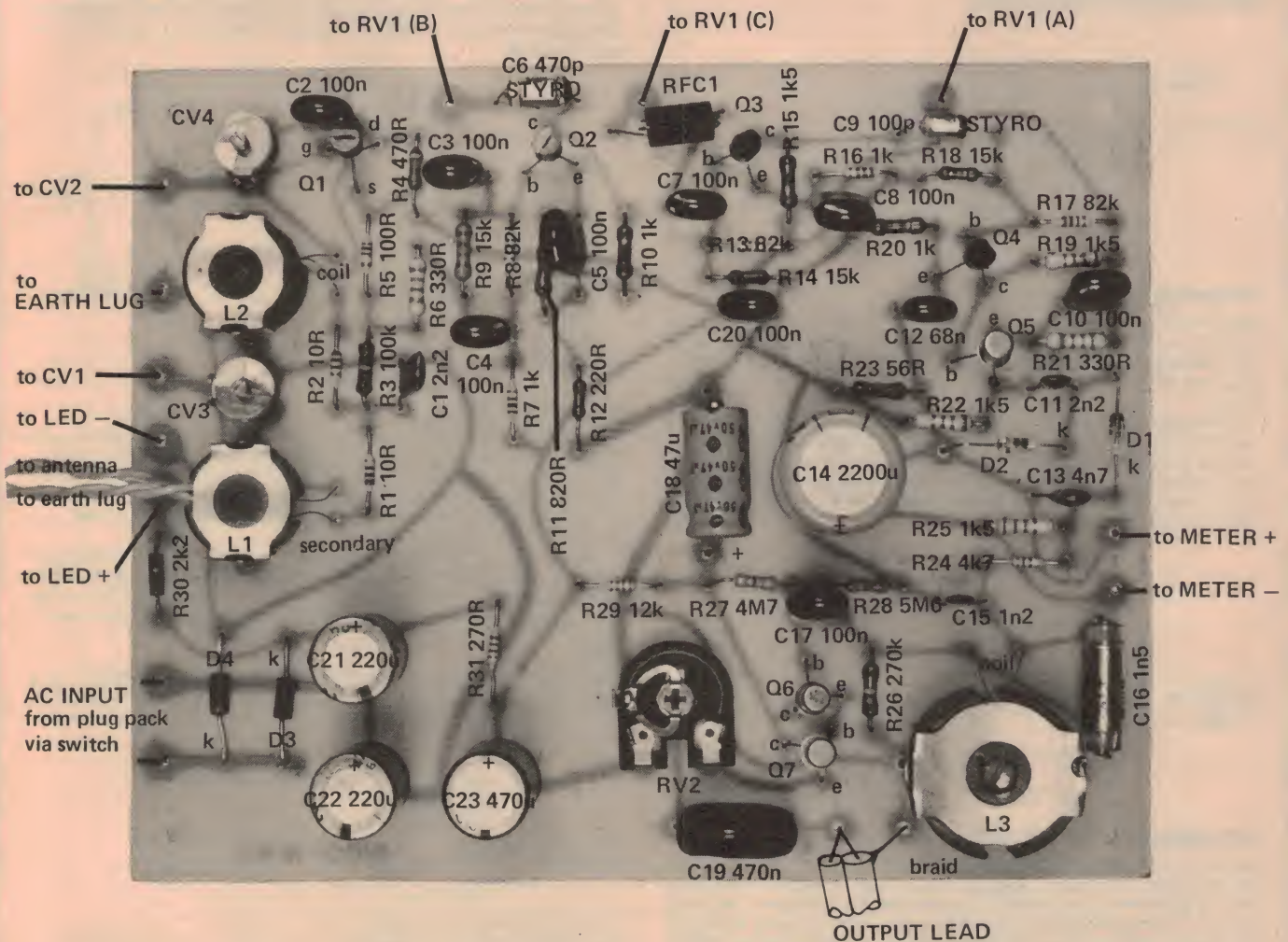
Arrange the wires so that all the link wires come out one side of the bobbin and the secondary wires come out the other.

Assemble the two ferrite pot core halves over the former, place the washer on top of the assembly and slip on the clip. The washer ensures an even pressure is transmitted from the clip to the ferrite assembly and should always be used with these small pot cores. Insert the adjuster carefully into the centre hole of the core using a small aligning tool. Take care as it cuts its own thread in the nylon insert and any forcing can damage this.

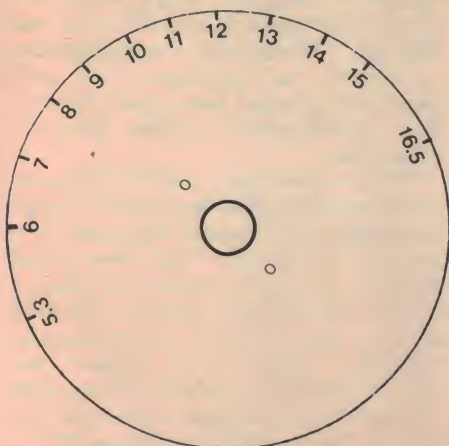
Solder the complete assembly into the pc board (before everything falls apart!) orienting the assembly with the link connections facing the edge of the board and the secondary connections toward the centre.

The second front end pot core, L2, is assembled in a similar way but note

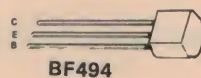




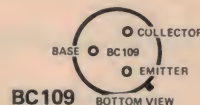
**NOTE:** Space problems prevent us publishing the pc board pattern this month. A good quality photostat may be obtained by sending a large, stamped-addressed envelope to 'AM Tuner PCB' c/o the magazine. We will endeavour to publish the pc board next month.



Full-size reproduction (negative) of the dial.



BF494



BC109 BOTTOM VIEW

that it has no link.

The whistle filter, L3, uses a 26 mm diameter pot core which is assembled in a similar fashion to the other two except that it does not require a washer under the clip. Wind the wire on the bobbin as detailed in the accompanying box. The wire should almost fill the former, so be careful to wind it firmly, laying the turns neatly on the bobbin.

## Tuning up

Turn the unit on and connect it to your stereo amp. Turn trimpot RV2 on the pc board fully clockwise. Connect an antenna and turn the RF gain control fully clockwise. Set the two trimmer capacitors at mid range (you can see the plates), and the ferrite adjusters in L1 and L2 at half depth. Tune over the

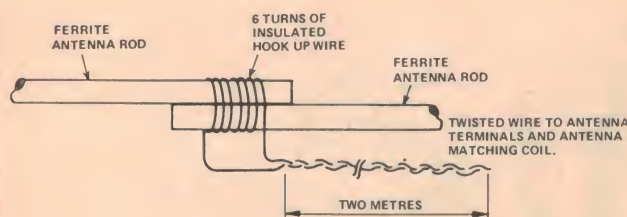
range and you should hear some stations. Select a station at the high frequency end of the range. By adjusting the two trimmers in turn, and the tuning capacitor, bring the station to its correct position on the dial. This requires a little juggling with the three adjustments. Next, find a station at the low frequency end of the dial and repeat the procedure, this time tuning in the station using the two ferrite pot core adjusters and the tuning capacitor. You now have the receiver roughly aligned.

Repeat the process but this time you can set the dial to where a station should be located on the dial (according to the markings) and tune the two trimmers for maximum signal on the meter. Repeat for a low frequency station, adjusting the pot cores.

Repeat once more, just to make sure, ►



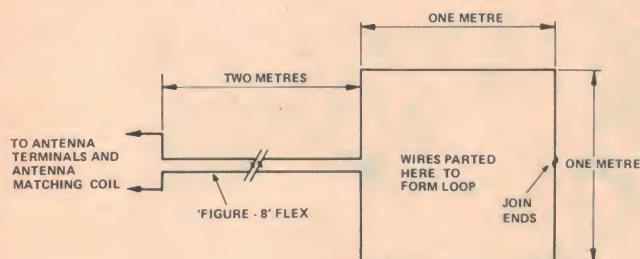
## SUGGESTED ANTENNAS



### For strong signal areas

This antenna is constructed of two 13 mm diameter ferrite rods. We suggest Neosid types, of F8 material, 12.7 mm diameter by 100 mm long. Most ferrite rods intended for broadcast band 'loopstick' antenna applications will probably suffice though, as construction is not all that critical; performance may vary though.

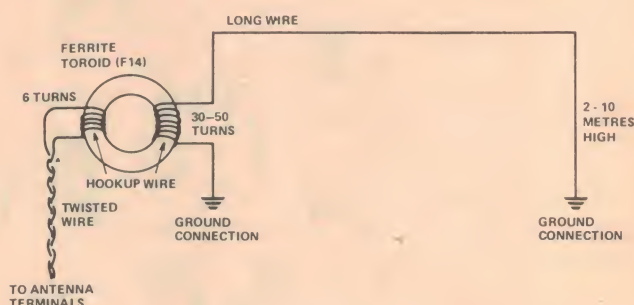
Six turns of hookup wire are wound firmly around the two rods and twisted leads two metres long connect to the tuner's antenna terminals. The two ferrite rods may be extended as illustrated or pushed together so that they overlap over more of their length. As shown, the antenna provides maximum sensitivity and least directivity. The rods should be oriented for best reception for the station or stations of interest.



### For medium to weak signal areas

A loop antenna can provide very good results where signals are not too strong. The loop illustrated is made by taking a length of 'figure-8' flex, parting the wires over a length of two metres, joining the free ends and forming a loop of one metre per side. The feedline should be about two metres long. It can be longer but performance may deteriorate. The plane of the loop should be oriented towards the transmitters for best results.

A larger loop may be constructed to improve pickup. Note that a rectangular loop may also be used, if more convenient. Experimentation will indicate which arrangement provides satisfactory results. A matching coil, as shown, may improve results.



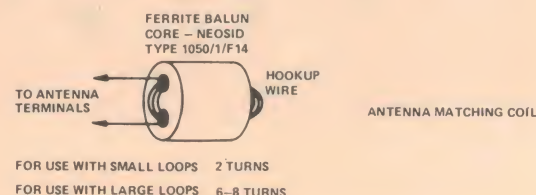
### For weak signal areas

If you live in a weak signal area, or want to 'chase the DX', this antenna should provide good results. Run a long, straight wire as high above the ground as you can reasonably manage and as long as will fit in your property (but less than 5 km!). Connect the furthest end to a ground stake. The opposite end connects to the primary of a 'matching' transformer wound on a ferrite toroid. The illustration shows the main details.

The toroid should be of a material having an initial permeability of about 200 to 300, at least, and an  $A_L$  factor of around 100 to 150. A Neosid toroid of F14 material, 25.4 mm outside diameter, 19.05 mm inside diameter and 9.5 mm high should do nicely. It's not too critical, and some experimentation may be in order.

### Note

The impedance of the antenna will have some effect on the tuning of L1. This may necessitate minor re-alignment of the adjuster in L1 if you change antennas or change the position of the antenna. Check the alignment at the low frequency end of the band.



and you should notice that all the stations are in their correct positions on the dial. If you change antennas you may need to make a slight re-adjustment to L1.

The whistle filter can be adjusted by tuning across the dial until you find a 9 kHz whistle between two stations. Wind the ferrite adjuster on L3 in until the tone disappears. If no whistles are found, wind the adjuster all the way out.

An alternative method is to use a signal generator with external AM modulation. Set the modulation to 9 kHz, at about 80%, and tune in the signal. Use the ferrite adjuster on L3 to null the audio from the speaker.

Always use proper adjusting tools (these are available from most suppliers) to avoid breaking the adjusters or affecting their correct operation. The pot core adjusters are

delicate and should be treated with kindness. Overzealously screwing them in and out will almost certainly result in permanent damage.

This fairly simple alignment technique yielded an overall bandwidth, at the -3 dB points, extending from 15 Hz to 12 kHz. For those readers with a little more perseverance, this can be improved with judicious adjustment of the tuned circuits.

## Operation

With the unit aligned you can connect an antenna and enjoy sounds from an AM tuner you never thought possible!

The output level to your stereo amplifier may be set by adjusting RV2, a trimpot on the pc board. The setting will depend on the signal strengths of the different stations at your location and the tuner input sensitivity of your

amplifier. It is best set by experiment.

The antenna required will depend, again, on the signal strengths of the various stations at your location. It is a wise move to spend a bit of effort here as it pays off. The accompanying box shows a variety of antennas that will generally provide more than satisfactory performance under different conditions.

We tried the tuner in different areas of metropolitan Sydney and were quite impressed with the performance. At a location on the north side, where local stations are quite strong, we used a simple ferrite rod antenna with good results. At our offices in the eastern suburbs, where some stations are relatively weak (especially 2JJ) we used a small loop antenna with excellent results. Sound quality is remarkable — you have to hear it to believe it!

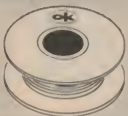




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WHY NOT JUST WRAP?

JW-1-B	BLUE WIRE
JW-1-W	WHITE WIRE
JW-1-Y	YELLOW WIRE
JW-1-R	RED WIRE



## JUST WRAP REPLACEMENT ROLLS

R-JW-B	BLUE WIRE	50 ft. Roll
R-JW-W	WHITE WIRE	50 ft. Roll
R-JW-Y	YELLOW WIRE	50 ft. Roll
R-JW-R	RED WIRE	50 ft. Roll



## UNWRAP TOOL FOR JUST WRAP

JWU-1	UNWRAPPING TOOL
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## JUST WRAP KIT

JWK-6	JUST WRAP KIT
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## "HOBBY" WIRE WRAPPING TOOL BATTERY POWERED

Use "C" size NICAD Batteries, not included. Bits not included.

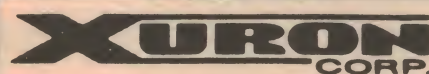
BT-30	BIT FOR AWG 30
BT-2628	BIT FOR AWG 26-28



## HOBBY WRAP TOOLS

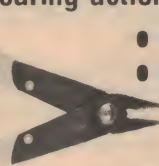


WSU-30	REGULAR WRAP
WSU-30M	MODIFIED WRAP



NEW

Cutters have a new patented shearing action



- Very thin profile
- Low operator fatigue
- Low cost
- Long life



## TRI-COLOR DISPENSER

WD-30-TRI	TRI-COLOR DISPENSER
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R-30-TRI	REPLACEMENT ROLLS
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## WIRE DISPENSER

WD-30-B	BLUE WIRE
WD-30-Y	YELLOW WIRE
WD-30-W	WHITE WIRE
WD-30-R	RED WIRE

## DISPENSER REPLACEMENT ROLLS

R-30B-0050	30-AWG BLUE 50 FT. ROLL
R-30Y-0050	30-AWG YELLOW 50 FT. ROLL
R-30W-0050	30-AWG WHITE 50 FT. ROLL
R-30R-0050	30-AWG RED 50 FT. ROLL

\*KYNAR-FENNWALT



## HOOK-UP WIRE

HK-18	18 AWG	25 FT.	SOLID CONDUCTOR
HK-20	20 AWG	25 FT.	SOLID CONDUCTOR
HK-22	22 AWG	50 FT.	SOLID CONDUCTOR
HK-24	24 AWG	50 FT.	SOLID CONDUCTOR
HK-26	26 AWG	50 FT.	SOLID CONDUCTOR
SHK-18	18 AWG	25 FT.	STRANDED CONDUCTOR
SHK-20	20 AWG	25 FT.	STRANDED CONDUCTOR
SHK-22	22 AWG	50 FT.	STRANDED CONDUCTOR
SHK-24	24 AWG	50 FT.	STRANDED CONDUCTOR
SHK-26	26 AWG	50 FT.	STRANDED CONDUCTOR

## PRB-1 DIGITAL LOGIC PROBE

- DC to > 50 MHz
- 10 Nsec. pulse response
- 120 K  $\Omega$  impedance
- Automatic pulse stretching to 50 Msec.
- Automatic resetting memory
- Open circuit detection
- Automatic threshold resetting
- Compatible with all logic families 4-15 VDC
- Range extended to 15-25 VDC with optional PA-1 adapter
- Supply O.V.P. to  $\pm$  70 VDC
- No switches/no calibration

PRB-1 DIGITAL LOGIC PROBE



## PROTOTYPE BOARD (CM-100)

TERMINALS: 1,020 TEST POINTS, 188 separate 5 point terminals, plus 2 horizontal bus lines of 40 common test points each.

SIZE: 6 1/2" Wide, 5" Long.

CM-100 MODULAR PROTOTYPE BOARD



## PROTOTYPE BOARD (CM-200)

TERMINALS: 630 TEST POINTS, 94 separate 5 point terminals, plus 4 bus lines of 40 common test points each

SIZE: 6" Wide, 3 1/2" Long.

CM-200 MODULAR PROTOTYPE BOARD

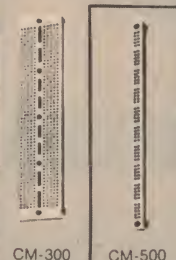


## PROTOTYPE BOARD (CM-300, CM-400)

CM-300 and CM-400 have two separated rows of five interconnected contacts each. Each pin of a DIP inserted in the strip will have four additional tie-points per pin to insert connecting wires. They accept leads and components up to .032 in. diameter. Interconnections are readily made with RW-50 Jumper Wire. All contact sockets are on a .100 in. square grid (1 1/4 in. wide).

CM-300 MODULAR PROTOTYPE BOARD

CM-400 MODULAR PROTOTYPE BOARD



## MODULAR BUS STRIP

CM-500 is a bus strip to be used in conjunction with CM-300 and CM-400 for distribution of power and common signed lines. Two separate rows of common terminals, grouped in clusters of five. All contact sockets are on a .100 in. square grid.

CM-500 MODULAR BUS STRIP



## DIP IC INSERTION TOOLS WITH PIN STRAIGHTENER

Narrow profile. Pin straightener built into tool. Automatic ejector.

INS-1416 14-16 PIN DIP/IC INSERTER

STRAIGHTEN PINS RELEASE PICK UP INSERT

## MOS, CMOS-SAFE

GROUND STRAP NOT INCLUDED

MOS-1416	14-16 PIN, MOS CMOS SAFE INSERTER
MOS-2428	24-28 PIN, MOS CMOS SAFE INSERTER

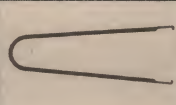


## 36-40 PIN (MOS-SAFE) IC INSERTION TOOL

Aligns bent out pins. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

MOS-40 36-40 PIN CMOS SAFE INSERTION TOOL



## DIP IC EXTRACTOR TOOL

Extracts all LSI, MSI and SSI devices of from 8 to 24 pins.

EX-1 EXTRACTOR TOOL



## 24-40 (MOS-SAFE) EXTRACTOR TOOL

Removes 24-40 pin IC's, .600" centers. C-MOS safe. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

EX-2 CMOS SAFE EXTRACTOR TOOL



**A ONCE-ONLY OFFER!**



# SUPERB REEL TO REEL TAPES

Dindy Marketing have a limited quantity of these EMI tapes available, **only for the duration of this offer** (unless sold out before the offer expires) so rush your order now. These tapes will not be offered again as EMI is ceasing production.

NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and ETI is acting as a clearing house only. Cheques or money orders should be made payable to 'EMITAPE OFFER' and sent, together with the coupon (or a photostat or clear, handwritten copy of same), to Emitape Offer, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011. We will then process your order and pass it on to Dindy who will send you the goods. Please allow up to four weeks for delivery.

## Send coupon to: EMITAPE OFFER

ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011

Quantity .....	900 x 5/825 .....	\$ .....
.....	1800 x 7/825 .....	\$ .....
.....	2400 x 10 1/2/816 .....	\$ .....
.....	10 1/2" NAB reels .....	\$ .....
1 - 9 tapes	\$2.50	Packing & delivery: .. \$ .....
10 - 29 tapes	\$3.50	
30+ tapes	\$4.00	<b>TOTAL: \$ .....</b>

(Tapes can be mixed for quantity discounts)

Name .....

Address .....

..... Postcode .....

Cheque or money order .....

Or use your Bankcard 

4	9	6																	
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 Expiry Date .....

Signature .....

## EMITAPE 816 MATT BACKED PROFESSIONAL AUDIO TAPE

The advantages of back-coated tapes — such as high spooling speeds and uniform wind under adverse conditions, together with the reduced risk of edge-damage — are already widely recognised. These advantages are frequently obtained, however, at the expense of other, no less important characteristics. The most significant adverse effects are deterioration in amplitude modulation noise, caused by imprint effect from the backing on to the oxide during storage, and a higher degree of head and guide wear.

The development of **EMITAPE 816** has been concentrated on eliminating these disadvantages while combining the benefits of matt backing with the stringent audio performance. **EMITAPE 816** is a standard play professional audio tape, its polyester base having a specially treated back coating.

**EMITAPE 816** is not recommended for use on recorders using pressure pads.

### AUDIO PERFORMANCE SPECIFICATION 38.1 cm/sec (15in/sec)

REFERENCE BIAS		1 dB over bias at 1 kHz (this condition is that with increase of bias current the 1 kHz output level has fallen by 1 dB from its maximum value).
1. Sensitivity at	1 kHz	0 dB
	4 kHz	+1.5 dB
	10 kHz	+2.5 dB
	16 kHz	+4 dB
2. Bias current ratio at 1 dB over bias (at a frequency of 1 kHz)		0.87
3. Maximum Output Level for 3% third harmonic distortion at 1 kHz (Ref. 1)		+6 dB
4. Maximum Output Level for saturation at 10 kHz (Ref. 1)		+5.25 dB
7. The ratio of the 1 kHz Maximum Output Level to Bias Noise		74.5 dB full track (6.25 mm tape width)
8. The ratio of the 1 kHz Maximum Output Level to Bias Noise		66 dB full track (6.25 mm tape width)
9. The ratio of the 1 kHz Maximum Output Level to print first pre-echo after storage for 72 hours at +20° C.		58 dB

Ref. 1 Relative to an RMS flux of 320 nWb/m tape width (32 mMx./mm.) at a frequency of 1 kHz.  
Ref. 2 Measured in accordance with the paper by E.G. Trendell entitled "The Measurement and Subjective Assessment of Modulation Noise in Magnetic Recording", Journal of the Audio Engineering Society, December 1969, Volume 17, Number 6.



## Tapes available

EMITAPE 825 900ft (274 m) on 5" (133 mm) reels (quantity: 800)  
 EMITAPE 825 1800ft (549 m) on 7" (178 mm) reels (quantity: 4500)  
 EMITAPE 816 2400ft (732 m) on 10½" (267 mm) metal reels with NAB hub (quantity: 1100)  
 Metal Reels — 10½" (267 mm) with NAB hubs; boxed.

Tapes can be mixed for quantity discounts.  
 These prices are around half what the tapes were selling for originally.

## OFFER PRICES

	1 - 9	10 - 29	30+
900 x 5, 825 tape	\$3.99	\$3.69	\$2.98
1800 x 7, 825 tape	\$6.99	\$6.28	\$5.88
2400 x 10½, 816 tape	\$16.99	\$15.27	\$13.85
10½" Metal Reel — \$9.97, any quantity.			

**Order now and ensure delivery before Christmas !**  
**Offer closes 13 November**

## EMITAPE 825. LOW NOISE LONG PLAY PROFESSIONAL AUDIO TAPE

EMITAPE 825 is a low noise long play audio tape which was specially developed for professional studio mastering and broadcasting. This tape has an excellent signal to print ratio and a specially treated coating which gives extremely low head wear and low modulation noise. The wide frequency response obtainable from this tape ensures an excellent high fidelity performance when used in conjunction with any good quality tape recorder.

### AUDIO PERFORMANCE SPECIFICATION

	19.05 cm/sec (7½in/sec)	9.53 cm/sec (3¾in/sec)
Recommended Bias	1 dB overbias at 1 kHz (the value of bias used by the majority of professional recording and broadcast engineers)	The value of bias current required to record a 333 Hz signal which when reproduced gives an output level of +3 dB (Ref. 1a) with a third harmonic distortion content of 5%
Frequency Response (when compared with EMI Standard Tape S.4)	Within +/−2 dB from below 31.5 Hz to 16 kHz	Within +/−2 dB from below 31.5 Hz to 16 kHz
Maximum Output Level	+3 dB (for 3% Third Harmonic Distortion at 1 kHz (Ref. 1))	+3 dB (for 5% Third Harmonic Distortion at 333 Hz (Ref. 1a))
Maximum Output Level (for Saturation at 10 kHz)	−1 dB (Ref. 1)	−7 dB (Ref. 1a)
Maximum Output Level (for Saturation at 10 kHz)	−1 dB (Ref. 1)	−7 dB (Ref. 1a)
Signal to Noise Ratio (a) Weighted in accordance with IEC 123A, BS3489-1962 (A Curve) and ASA Standard S1-4-1961 (A curve) using a measuring instrument with the same dynamic characteristic as a Standard Volume Indicator (BS3489-1962 and ASA Standard C16-5-1961)	66 dB (Ref. 2)	58 dB (Ref. 2a)
(b) Weighted using a filter and a quasi peak measuring instrument in accordance with DIN45405	57 dB (Ref. 2)	51.5 dB (Ref. 2a)

Ref. 1	Relative to an RMS flux of 320nWb/m tape width (32mMx/mm) at a frequency of 1 kHz.
Ref. 1a	Relative to an RMS flux of 250nWb/m tape width (25mMx/mm) at a frequency of 333 Hz.
Ref. 2	The ratio of the 1 kHz Maximum Output Level to Bias Noise.
Ref. 2a	The ratio of the 333 Hz Maximum Output Level to Bias Noise.

**Note** The figures quoted are mean values and subject to manufacturer's tolerances.

# LIGHTING AS FLEXIBLE AS YOUR THINKING...

... that's what Sevlén Lighting offers you. The most portable, economical and adaptable low priced lighting system ever invented, a must for clubs, displays, windows and dance venues.

Connected via a new advanced locking mains line socket to a four channel STARCHASER controller, an amazing sequence is produced all within a tube. No complicated connections, no wiring, no messy installation problems, just plug on — take it anywhere, anytime. Bend it, shape it, hang it overhead, on stairs or ceilings.

If you need more, just connect another snakelight on to the other end — (each \*snakelight is 10 metres long). Up to 300 metres of scintillating, pulsating chase.

The new connectors introduced are locked together when plugged in and cannot be accidentally separated while in use. The special miniature lamps have a unique continuity link which ensures that even if one lamp fails, the whole circuit continues to work without interruption

\*12 different colours available.



## SEVLEN LIGHTING PTY. LTD.

### MANUFACTURERS OF LIGHTING CONTROL SYSTEMS

Office: 4 Weldon Street, Burwood, 2134, NSW  
 Telephone (02) 74-8905





## Get the car cover that covers Australia.

Buying car insurance from the place on the corner is fine.

But what happens when you have an accident far away? Say on holiday, in another state.

Where is that place on the corner when you need them?

Still back on the corner?

The difference with AGC is that we cover Australia.

So wherever you drive, you won't be left stranded.

You can process your claim on the spot and get fast claim settlement.

And that's just one of the beauties of being with AGC.

We also offer you an easy Pay-by-the-Month Car Insurance.

And we have a no-claim bonus that reaches 60% in just four years and you do not lose all that bonus for one claim.

The more you think about it,

the more AGC leaves the others behind.

Sydney: Phillip & Hunter Streets.

Melbourne: 31 Spring Street.

Brisbane: Tank Street & North Quay.

Adelaide: 10 Pulteney Street.

Perth: 165 Adelaide Terrace.

Hobart: 161 Collins Street, and offices throughout Australia.

AGC (Insurances) Limited.

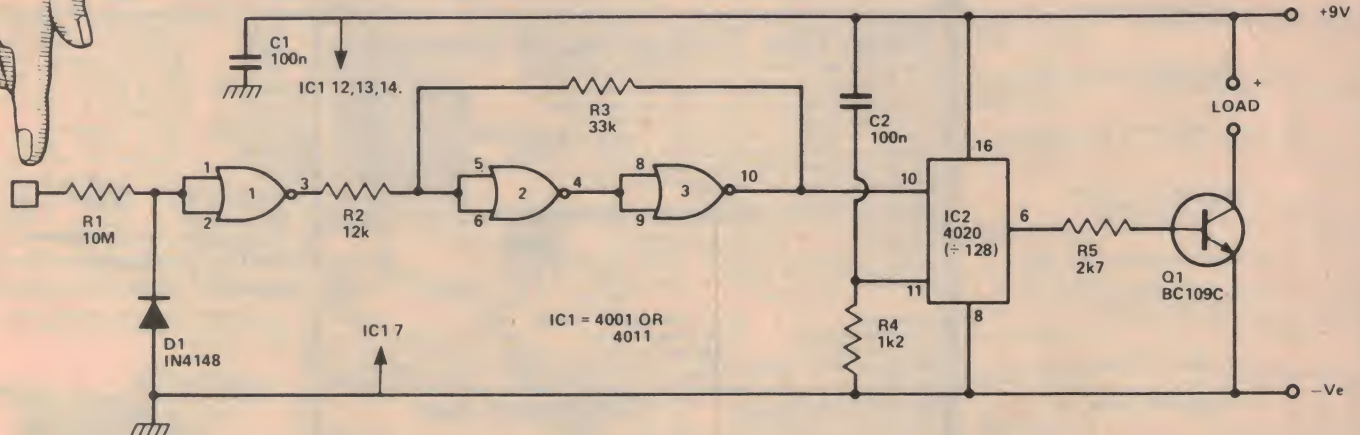
A division of Australian Guarantee Corporation Limited.

AGC991 FCB





## Touch switch



THIS TOUCH SWITCH is designed to provide on/off switching for 9 V battery operated equipment having a current consumption of up to 100 mA. It has a single touch contact which is briefly touched in order to change from on to off or vice versa. The circuit is operated by stray pick-up of mains hum which is coupled to the input of Gate 1 (which, like the other three gates employed in the unit, is connected to act as an inverter) via R1 when the input contact is touched.

As IC1 is a CMOS device it has a very high input impedance, and the input signal will be capable of switching the Gate 1 input from one logic state to the other. The input impedance of the circuit is so high that the reverse resistance of D1 is used to tie the input to earth under quiescent conditions, so as to prevent spurious operation. Resistor R1 acts as a low pass filter in conjunction with the input capacitance of the circuit, and this attenuates high frequency noise which may be present on the 50 Hz mains signal.

The output from Gate 1 still contains significant noise products, and also has a rise time which is inadequate to drive the final stage of the circuit. This is overcome by a trigger circuit using Gates 2 and 3. Resistor R3 tends to hold Gate 2 input in the same state as Gate 3 output, resisting any change in logic state caused by Gate 1 output due to the coupling through R2. This resistance to change is termed 'hysteresis'. Resistor R2 has a lower value than R3, and so

Gate 1 can operate the trigger circuit if its output signal is of adequate amplitude. The 50 Hz signal will be strong enough, but the noise spikes will not and are thus eliminated from the output of the trigger.

Once the output of the trigger does start to change state, the coupling through R3 provides a triggering action which ensures a rapid change.

IC2 is a 14 stage binary counter and Q1 is driven from the output of the seventh stage via a current limit resistor, R5. The C-R network consisting of C2 and R4 provides a positive reset pulse to the counter at switch on so that the outputs are all low and Q1 is switched off.

The controlled equipment forms the load for Q1 and obviously receives no significant power. If the touch contact is operated, a 50 Hz signal is fed to IC2 and the seventh stage output changes state every 64 pulses. As this output goes high and low the load is switched on and off. In practice the contact is touched just until the unit switches to the desired state (which one tends to do automatically).

The unit consumes only about one microamp in the "off" mode and

approximately 3 mA in the "on" state.

A suitable relay may be used as the load, its contacts may then be used to control mains-operated equipment.

## SORCERER OWNERS!

Upgrade your existing 8K Basic with the new Software Source Mod 1.01. Makes your Basic into a Superbasic with capabilities that outstrip even some Disc Basic.

- Full input checking to eliminate unseen syntax errors and line overflows.
- Redo from start if type mismatch in input statements.
- Save numeric arrays with confidence.
- Full line editing on input — change part of line without retyping it all.
- Full selective renumbering — move your subroutines around; make a hole to insert more text.
- Delete any block of lines.
- Full recovery of program after accidental reset.

Available only for Exidy Standard Basic version 1.0.  
Basic Mod 1.01 (include Rompac with order) \$125.00  
Available as kit with full instructions .....\$100.00

### OTHER SOFTWARE AVAILABLE

String Saver: save Exidy Basic string arrays .....	\$37.50
Eddit: merge/renumber/edit Basic programs .....	\$35.00
Moneychart: chart cashflow of any business .....	\$58.00
Management Report: see where & how money is spent .....	\$53.00
Supercalc: Sorcerer becomes a 'supercalculator' .....	\$12.50
Util 2: use your development pac efficiently .....	\$17.50
Life: play Conway's game superfast .....	\$8.50
BIO 99: plot your biorhythms fast .....	\$8.50

### SPECIAL INTRODUCTORY OFFER

C.10 Digital Cassette Tapes, box of 10, \$8.85.  
16 Sector 5 ¼ Diskettes, box of 10, Single Density  
\$40.00, Quad Density \$60.00.

If ordering Mod 1.01 please include your Basic 1.0 Rompac.

Send cheque/money order to:

SOFTWARE SOURCE,  
PO Box 364, Edgecliff, NSW 2027.

All prices inclusive. For free catalogue send SAE.  
Need specialised software? — call us, we can help.

**SOFTWARE SOURCE**

Phone (02) 33-4536

SHORT CIRCUITS is a feature that lies somewhere between Ideas for Experimenters and complete Projects. Generally, the items published in Short Circuits will involve tried circuits that have not necessarily been fully developed, but fairly complete details are included as a guide to readers. Unfortunately, owing to the nature of these items, we cannot give further details other than what is provided in the article. Contributions for Short Circuits are always welcome.



## PARTS FOR NEW KITS

If a kit you want to build is not listed, the parts may be available anyway. Check the Dick Smith Catalogue or call in to your nearest Dick Smith store.

**ACOUSTIC COUPLER (See EA September)**  
Complete kit, including maltwork, etc. Cat K-3605 \$75.00  
Printed Circuit Board only Cat H-8380 \$4.00

**EXPANDED SCALE AUTOMOTIVE VOLTMETER (See ETI Sept.)**  
Printed Circuit Board Cat H-8630 \$1.50  
LM3914 IC Cat Z-6295 \$4.25  
Choose round or rectangular, large or small LEDs to suit your particular application.

(Above kits are from magazines' forecasts. We will endeavour to have these kits on sale when the magazines are released; however, delays can occur! Please enquire at your nearest Dick Smith Store.)

**CHASER (See EA August)**  
Complete kit, including front panel Cat K-3145 \$69.50  
PCB only Cat H-8379 \$5.95

**NASA POWER CHOPPER (See EA August)**  
Short form kit (All components & PCB) Cat K-3325 \$16.50  
PCB only Cat H-8378 \$3.00

**LEDS AND LADDERS GAME (See EA August)**  
Complete kit inc. printed panel Cat K-3390 \$15.75  
PCB only Cat H-8378 \$3.00

**LED TACHO (See ETI August)**  
Short Form Kit (includes PCB components etc, but no case - build it into your dash board) Cat K-3240 \$24.50

**FAST NICAD CHARGER (See ETI August)**  
PCB only Cat H-8627 \$3.00  
(All other components in this kit are normal stock lines)

**GUITAR/PA PREAMP (See ETI August)**  
Short form kit PCB & components, no transformer or case Cat K-3035 \$29.50

**300 WATT AMPLIFIER (See EA June)**  
Printed Circuit Board only Cat H-8376 \$9.95  
(Most other components are normal stock lines)

**TV CRO ADAPTOR (See EA May)**  
Complete Kit Cat K-3060 \$29.95  
Printed Circuit Board Cat H-8375 \$5.75

## EA'S NEW ACOUSTIC COMPUTER COUPLER:

We've lost count of the number of customers who have asked for this project: well here it is! This acoustic coupler acts like a modem without any physical connection to the phone lines. It uses your standard telephone handset, placed over a small microphone and speaker in the coupler case, and transfers the information from your computer by sound. Hence the name, acoustic coupler. Now you can have your computer talk to another across the street, across the town - even across the country (or further)! It is a must for all serious computer users, and we hope to release the kit by the time this magazine is published.



KIT ONLY Cat K-3605 \$75.00

## SPECIAL OFFER FOR PROJECT BUILDERS

BUY A SHEET OF RED SCOTCHCAL, AND WE'LL GIVE YOU A BOTTLE OF DEVELOPER FOR NO EXTRA CHARGE!

Red Scotchcal (H-5892) \$8.00  
Developer (H-5896) \$1.00  
YOU PAY \$6.00

Have you found out how easy 'Scotchcal' is to use? And how it makes very professional front panels for all your projects? All you do is make up artwork (with ink, 'let's see', etc), expose the 'Scotchcal' to UV light (eg the sun) and develop it with Scotchcal developer. It's that easy! We're sure there are many hobbyists who haven't found out about Scotchcal - yet - so to introduce it to you, we're making a special offer: buy a sheet of Red Scotchcal for the normal price, and we'll throw in a bottle of developer as a bonus! Each sheet of Scotchcal comes complete with instructions for making your own front panels and labels, easily & quickly!

## HERE IT IS: THE NOVA 80

ONLY \$399.00

You'll find full details of this exciting new computer beginning in the October issue of Electronics Australia. But to what your appetite, check this out:

- Powerful BASIC interpreter included
- Z-80 based microprocessor
- Up to 48K RAM on-board
- S-100 compatibility
- Full 83 key keyboard 'on board'
- Both RF and Video outputs 'on board'
- Extremely reliable cassette interface
- All components (except power transformer) 'on board': simple assembly!

Cat K-3600

We're very excited about this dramatic new breakthrough in home computers. A really professional quality design, with the incredible versatility only S-100 can give you. If you've been putting off buying a home computer, lucky you: now you can build your own at a fraction of the cost of built-up models! (Full, explicit instructions supplied). Check out the Nova 80: you won't be disappointed!



## LEDS AND LADDERS GAME (See EA August): New, up-graded circuit is \$1 cheaper than it was 4 years ago!!!



One of our most popular kits of the past was the intriguing 'LEDS AND LADDERS' game described in Electronics Australia in 1975. Now EA have come up with a new version of the game which is not only easier to build, it is also simpler to play! Can you climb out of the well without being plummeted down again? And the best news of all: this kit is actually \$1.00 cheaper than it was in 1978 - despite four years of inflation! Hurry while this low price lasts!

WAS \$16.75 IN 1978  
NOW ONLY \$15.75!

Cat K-3390

## FOIL THE CHRISTMAS CROOKS!

Statistics show most robberies occur around Christmas time. Foil the felon's fitching this festive funtime: install a burglar alarm now and be really protected! (Don't put it off: you could be next on their list!)

This outstanding new Dick Smith two sector composite alarm module is made right here in Australia! It features very high reliability - a completely professional quality system for the home handyman to install. Entry and exit times are variable to comply with various state noise pollution laws; system gives positive indication of 'saw' by LEDs. Accepts all types of alarm triggering devices; both normally open and normally closed.

### ALARM ACCESSORIES:

**REED SWITCHES:**  
Twin set of magnet and reed switch. Wire them into windows and doors for protection. Cat L-5210 \$1.95

**PRESSURE MAT**  
Hide under carpets, mat etc. Pressure of person walking sets it off. Cat L-5270 \$14.95

**HORN SPEAKER:**  
Highly efficient horn plugs into alarm module. Mount under seats for distant warning. Cat C-2705 \$9.50

**GLASS BREAKAGE DETECTOR**  
Sticks to glass, responds only to sound of glass actually breaking. Easy to install. Cat L5230 \$29.50

### PROTECT YOUR CAR, TOO...

Fully integrated car protection with alarm & horn unit in one. Current sensing system; no external switches. Cat L-5090 \$49.50

### WOTTA BARGAIN!

We've just bought a HUGE shipment of these incredibly popular push button telephone dial in - so our cost has dropped power! Simply substitute for any rotary dial. Although these units fit perfectly into standard Aust. phones (no soldering required) current regulations do not allow you to use them for this purpose. Cat X-1175 \$39.50

NOW: \$39.50

### NEED A SAFE AC SUPPLY FOR YOUR PROJECTS?

Now about 12 volts at 500mA!!! Most plug-packs give you around 200mA. This one gives 500mA! The reason: it is ALL transformer. You put the rectifier, capacitors, etc. in the project; and plug in the AC supply. It's a great space saver! Cat M-9555 \$9.50

### INCREDIBLE CRO VALUE!

Since this superb CRO was released we've sold hundreds: it offers the hobbyist incredible value for money! A variable response up to 5.5MHz, plus a range of controls which make it easy to drive - you'll wonder how you got along without a CRO for so long! Check it out at your nearest Dick Smith store soon. It's worth it! Cat Q-1280

ONLY \$199.00

### ADAPT IT!

This snazzy plug converts banana sockets into a BNC type socket. Suits above CRO, lets you use many more accessories. Cat Q-1281 \$9.50

### PROBE IT!

Makes your job easier with this versatile probe set. Has 3 position slide switch and 1.5m cable. Complete with all accessories. Great value! Cat Q-1245 \$34.50

## EVER WONDERED WHERE TO BUY AN AUSSIE FLAG?



\$9.95

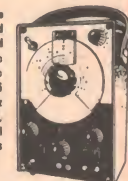
Cat X-1001

Dick couldn't buy an Aussie flag. So he thought 'I'll cure that problem' New Dick sells Aussie flags, so every true blooded, dinky-di Aussie can buy their very own Aussie flag to raise up the Regals every morning. These are the small economy size, (about 1 metre long). Just imagine: the only house on the street with your own flag!

Special note for Pomnies: Buy the flag, cut out the corner and you'll have your own personal size flag to remind you of home!

## NEW! AF & RF WIDEBAND SIGNAL GENERATOR

Here's a great new test instrument for the hobbyist and the professional. It's a wideband AF & RF signal generator, offering sine and square wave capability from 18Hz to 200MHz; is 8 ranges (AF is 18Hz to 220kHz; RF is 100kHz to 50MHz on 6 fundamental bands and 50MHz to 200MHz on fundamentals). It is all transistorised, compact and light weight - making it ideal for bench work or for the serviceman's toolbox. 240 volts AC operated.



ALL THIS FOR ONLY \$149.50

Cat Q-1305

## MAJOR DICK SMITH RE-SELLERS:

Listed below are re-sellers who stock a large proportion of our range. However, we cannot guarantee that they will have any or all of the items, or at the same prices, as those advertised on these pages.

**ATHERTON, QLD:** Tableland Radio Service

2 Jack Street, Phone 912 017

**BAIRNSDALE, VIC:** Odyssey Electronics

101 Main Street, Phone 525 282

**BENDIGO, VIC:** Sumner Electronics

85 Mitchell Street, Phone 431 877

**BLACKHEATH, NSW:** Goodwin Electronics

123 Station Street, Phone 878 378

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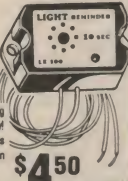
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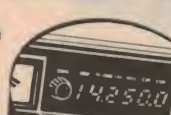
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We're often asked which of the electronics and computer magazines we have available. All of the following are normally stock; however some (especially overseas) magazines are in very limited quantities. Check with your nearest stores.

Cat No.	Title	Price
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B-5015	Electronics Today Int.	\$1.80
B-5030	Everyday Electronics (UK)	85c
B-5032	Practical Electronics (UK)	95c
B-5040	Wireless World (UK)	\$2.00
B-5044	Amateur Radio Action (Aust)	\$1.30
B-5050	QST (USA)	\$2.90
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PLEASE NOTE: Above magazines are not available from our Mail Order Centre.

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What we are trying to say is that, if you're about to drive across town to pick up a particular line at a Dick Smith store, why not give the store a ring first (addresses & phone numbers below)... just in case! Thanks.

**Dick Smith and Staff**

(Offer expires September 30, 1980)

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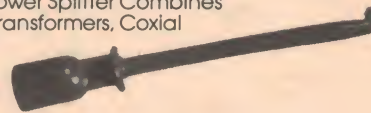
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### Stereo decoder HF 310

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The HF310 is a very reasonable priced HF FM tuner. Fully trimmed, the sensitivity according to IHF standards is better than 10uV. Features 60 dB S/N ratio and low harmonic distortion.

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### AT465 LIGHT SHOW

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Kit AT465 — \$65.00

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# Expanded-scale LED voltmeter has wide application

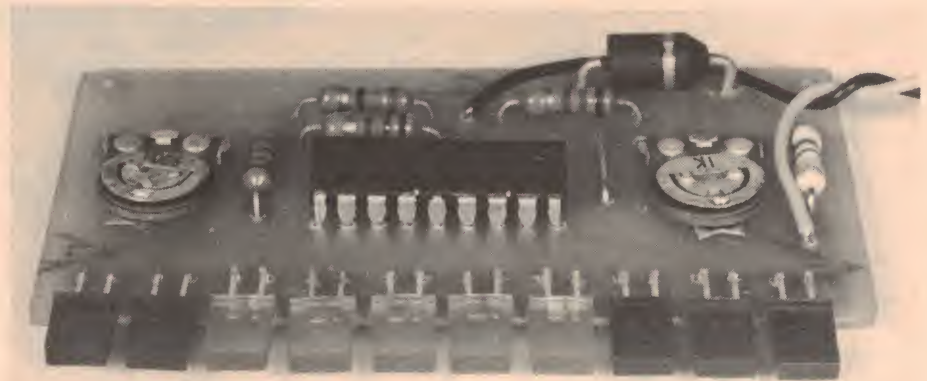
Phil Wait  
Simon Campbell

One of the most useful monitors of battery 'condition' is an expanded scale voltmeter. This novel, but nonetheless useful, project should find applications in vehicles, battery chargers etc.

THE 12 V BATTERY, in its many forms, is a pretty well universal source of mobile or portable electric power. There are lead-acid wet cell types, lead-acid gel electrolyte (sealed) types, sealed and vented nickel cadmium types, and so on. They are to be found in cars, trucks, tractors, portable lighting plants, receivers, transceivers, aircraft, electric fences and microwave relay stations — to name but a few areas.

No matter what the application, the occasion arises when you need to reliably determine the battery's condition — its state of charge, or discharge. With wet cell lead-acid types, the specific gravity of the electrolyte is one reliable indicator. However, it gets a bit confusing as the recommended electrolyte can have a different S.G. depending on the intended use. For example, a low duty lead-acid battery intended for lighting applications may have a recommended electrolyte S.G. of 1.210, while a heavy-duty truck or tractor battery may have a recommended electrolyte S.G. of 1.275. Car batteries generally have a recommended S.G. of 1.260. That's all very well for common wet cell batteries, but measuring the electrolyte S.G. of sealed lead-acid or nickel-cadmium batteries is out of the question.

Fortunately, the terminal voltage is also a good indicator of the state of charge or discharge. In general, the terminal voltage of a battery will be at a defined minimum when discharged and rise to a defined maximum when fully charged. Under load, the terminal voltage will vary between these limits, depending on the battery's condition.



The completed voltmeter. LED1 (10.5 V) is on the right and LED10 (15.0 V) is at far left.

Hence, a voltmeter having a scale 'spread' to read between these two extremes is a very good and useful indicator of battery condition. It's a lot less messy and more convenient than wielding a hydrometer to measure specific gravity of the electrolyte!

Let's look at battery characteristics, before we get into the project's circuitry, to get an understanding of what the project can do.

## Lead-acid batteries

The fully-charged, no-load terminal voltage of a lead-acid cell is between 2.3-2.4 volts. This drops under load to about 2.0-2.2 volts. When discharged, the cell voltage is typically 1.85 volts. The amp-hour capacity is determined from a 10 hour discharge rate. The current required to discharge the battery to its end-point voltage of 1.85 V/cell is multiplied by this time; e.g. a 40 AH battery will provide four

amps for 10 hours before requiring recharge. Note however that the amp-hour capacity varies with the discharge current. The same battery discharged at a rate of 10 amps will not last four hours, on the other hand if it is discharged at 1 amp it will last somewhat longer than 40 hours. The typical discharge characteristics of a (nominal) 12 V battery are shown in Figure 1.

The initial charging current for the fully discharged battery (cell voltage under 2.0 V), should be about 20 amps per 100 amp-hours of capacity (i.e. 8 amps for a 40 AH battery). Once the electrolyte begins to gas rapidly, the terminal voltage will be around 13.8 volts and rising rapidly. At this point, the charging current should be reduced to somewhere between 4-8 amps per 100 AH until charging is complete.

At the end of charging, terminal voltage may rise to about 15.6 volts or



more but this decreases slowly after the charger is removed, the terminal voltage then usually reading around 14.4 volts per cell (see Figure 2.).

## NiCad batteries

The no-load terminal voltage of a nickel-cadmium cell is typically 1.3-1.4 volts. This drops to about 1.2 volts under load, and to about 1.1 volts when discharged. As the electrolyte does not change during discharge (as it does in lead-acid batteries), the number of amp-hours obtained from a Nicad battery is much less affected by the discharge rate than are lead-acid batteries (see Figure 3.). Ten individual cells are generally used to obtain 12 V.

A number of charging systems can be used to replenish the charge in NiCad batteries. Constant current chargers are well known and quite common (such as the ETI-578 in the June 1980 issue). Fast charging at a high rate, as illustrated in the ETI-563 Fast Charger, is another method while some commercial manufacturers (Christie Electric Asia, for example) employ the "reflex" technique — the battery is alternately charged and discharged at a high rate over a short period. Increased battery life and extremely rapid charging are the claimed features of this method.

The typical charging characteristics of a single cell are illustrated in Figure 4.

For more details on lead-acid and nickel-cadmium batteries, see "Batteries" in ETI, November 1977.

## The voltmeter

This voltmeter uses ten LEDs to provide an 'expanded' voltage scale over the range 10.5 V to 15 V to suit applications with 12 V (nominal) batteries. Heart of the device is an LM3914 LED bargraph driver chip. In this application, we are using it in the 'dot' mode to provide an unambiguous display. The IC has been connected in this circuit such that the first LED (LED1) lights at 10.5 V, the second at 11.0 V and so on at 0.5 V intervals up to 15 V at LED10. Red LEDs have been employed at the extremes of the range to indicate 'problem' conditions. The first three LEDs, covering 10.5 - 11.0 - 11.5 volts, are red to show the discharge condition, while the last two LEDs, covering 14.5 and 15.0 volts,

are also red to indicate the overcharge condition. The LEDs covering the 12.0 to 14.0 volts range are all green showing that the battery's within its normal operating voltage range.

An 'idiot' diode (ZD1) and a line fuse protect the instrument in the event of reverse connection or an over-voltage condition. Should the unit be inadvertently wired in reverse polarity, ZD1 will conduct in the forward direction and the line fuse will blow. If a voltage greater than 18 V is applied, which may happen if the unit is installed in a car and a battery terminal comes loose allowing the alternator voltage to rise, then the zener action of ZD1 will cause the line fuse to blow, preventing too high a supply voltage from destroying the unit. ▶

## VEHICLE BATTERY FAULTS

Symptom	Probable cause
☆ Voltage falls rapidly to low end of green after engine is switched off.	Battery in poor condition or possibly faulty. Check terminals for good connection.
☆ Battery voltage falls considerably overnight	ditto
☆ Voltage falls rapidly from high end of green to low end if lights switched on with engine off.	ditto
☆ Voltage falls more than about one volt when lights are switched on with engine running at moderate speed	Charging system may be supplying low current. Check alternator slip rings, diodes and regulator adjustment. Check battery terminals.
☆ Voltage rises over 14.5 V (LED9) when engine running	Charging system may be overcharging. Check regulator voltage adjustment.
☆ Voltage never rises to top end of green (LED8).	Charging voltage too low. Adjust regulator voltage.

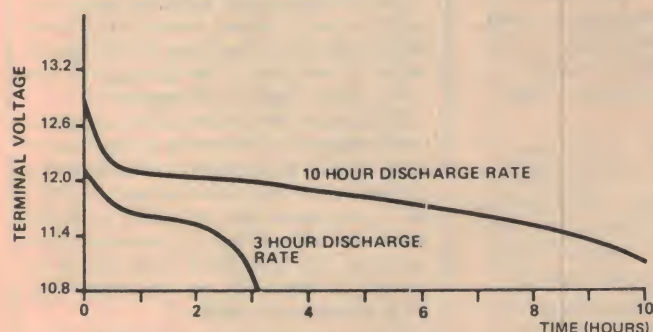


Figure 1. Typical discharge characteristics of a 12 V (nominal) lead-acid battery.

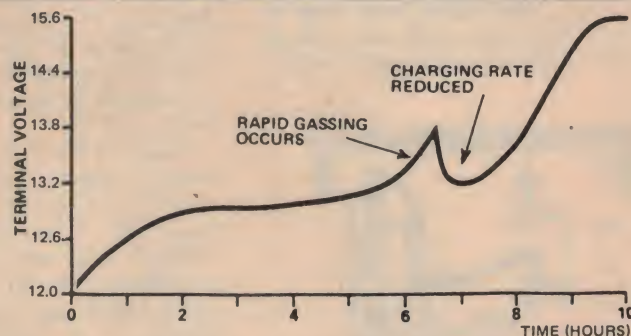


Figure 2. Charging characteristics of a 12 V (nom.) lead-acid battery. The 'kink' in the curve near 6 hrs is explained in the text.

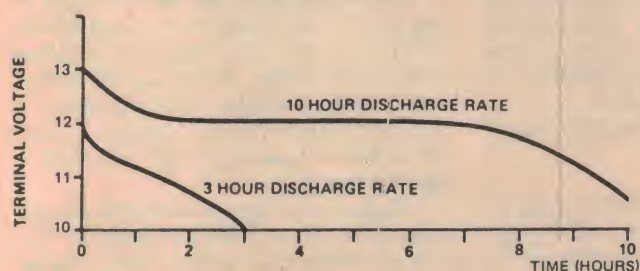


Figure 3. Typical discharge characteristics of a 12 V (nom.) nickel-cadmium battery (usually consisting of 10 cells in series).

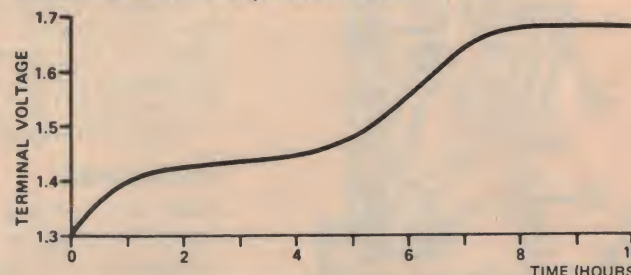


Figure 4. Typical charging characteristics of a single nickel-cadmium cell charged at 1.4 times the discharge rate.



# Project 326

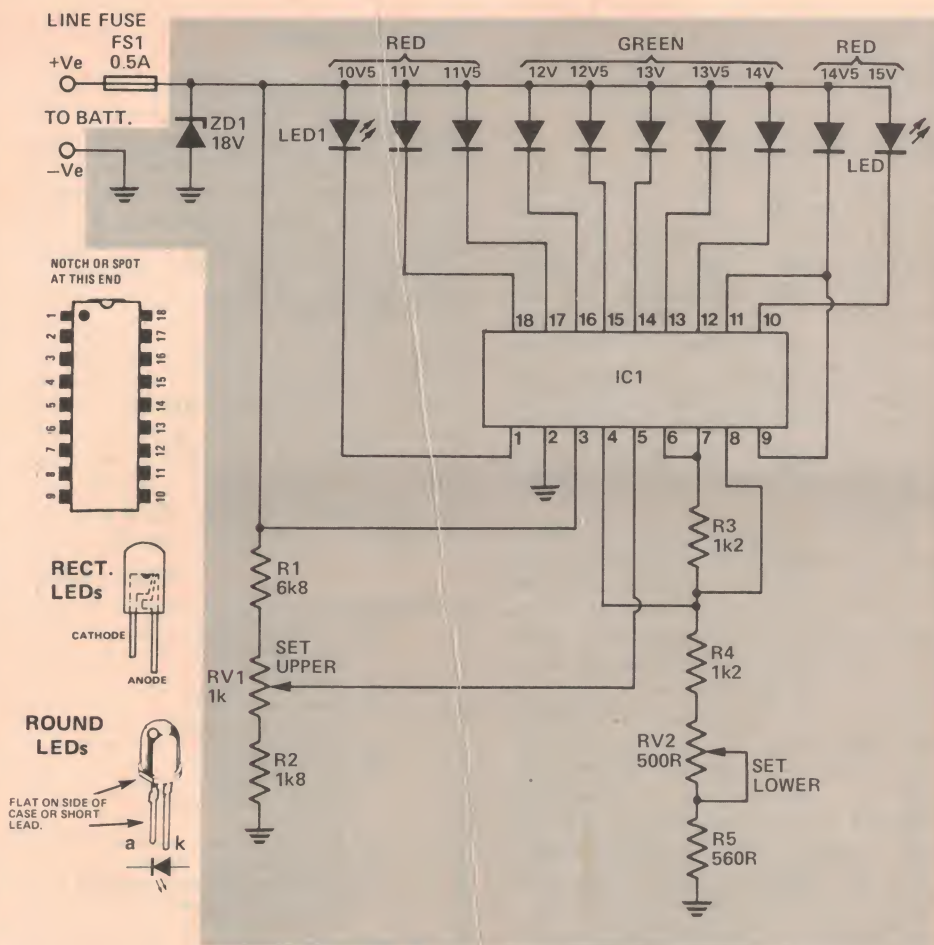
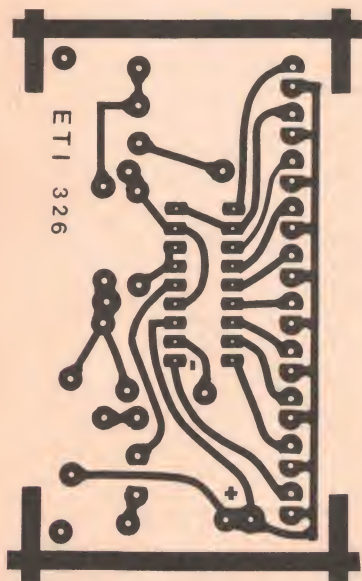
## Construction

Assembling the project is extraordinarily simple! We recommend you use the printed circuit board — it does make things easier and helps avoid mistakes, although it is not essential.

As with our LED Tacho (ETI-324) we have used rectangular LEDs and mounted them in a row down the front of the pc board. The components may be mounted in any order, but you might find it easier with this project to mount the LEDs first. It is *most important* that they be placed in the board the right way round. About the best way to ensure this is to place them on the table or workbench in front of you with all their leads correctly oriented, just as they would be when mounted in the board. Refer to the overlay and you can't go far wrong. The hard part is getting them all level! Starting at LED1 or LED10 — it doesn't matter which, insert its leads in the board and then bend it over such that it lies flat on the board with the base of the LED flush with the edge of the board. This is clear from the overlay picture. Solder the leads and bend the LED back upright. Insert the next LED carefully positioning it so that it is flush with the first LED and solder its leads. Proceed like this until all the LEDs are in place and then bend the whole row over, parallel to the board.

Note that, although we have used rectangular LEDs, conventional types may also be employed.

If you haven't already done so, the rest of the components may now be mounted. Take care with the orientation of the LM3914 and the zener diode.



## Setting the scale limits

To set the scale limits, you will need a variable power supply capable of delivering 15 volts and perhaps a good multimeter or digital voltmeter — the latter is preferable. Whatever you use, you should be able to read it reasonably well to 0.5 V.

Connect the instrument to the power supply (watch polarity), set the supply to 15 V and switch on. Any of the LEDs may light. Adjust RV1 until LED9 just extinguishes and LED10 lights. Next, set the supply to 10.5 V and adjust RV2 until LED1 just lights. Run the power supply up to 11.0 V and check that LED2 lights and LED1 goes out.

As there is some interaction between the two controls, repeat the process until the unit performs properly. The LEDs should light in turn at each 0.5 V interval from 10.5 V to 15.0 V.

Your LED voltmeter is ready for use!

## Installation

We'll have to leave this pretty much to you as installation details will depend on the individual application. However, if you plan to mount the unit in a vehicle, here are some general hints.

## HOW IT WORKS — ETI 326

The circuit uses an LM3914 LED bargraph driver arranged as an expanded scale voltmeter with a dot display, in which only one of the ten LEDs is lit at any time. If the voltage is below 10 volts none of the LEDs light, if it is above 15 volts the last LED remains lit.

The trimpots RV1 and RV2 set the upper and lower voltages respectively to give a range of 10 to 15 volts in ten steps. Over-voltage and reverse voltage protection is provided by ZD1, an 18 volt zener, and the fuse FS1. If the voltage exceeds 18 volts the zener conducts and blows the fuse, and if the voltage is reversed, the zener acts as a forward-biased diode with the same result.

The instrument can be mounted in any convenient position in or under the dash, provided the display is shielded from direct light. Seeing as the driver only need glance at it occasionally, it may be mounted away from his normal view, but not such that it's an effort to see the display.

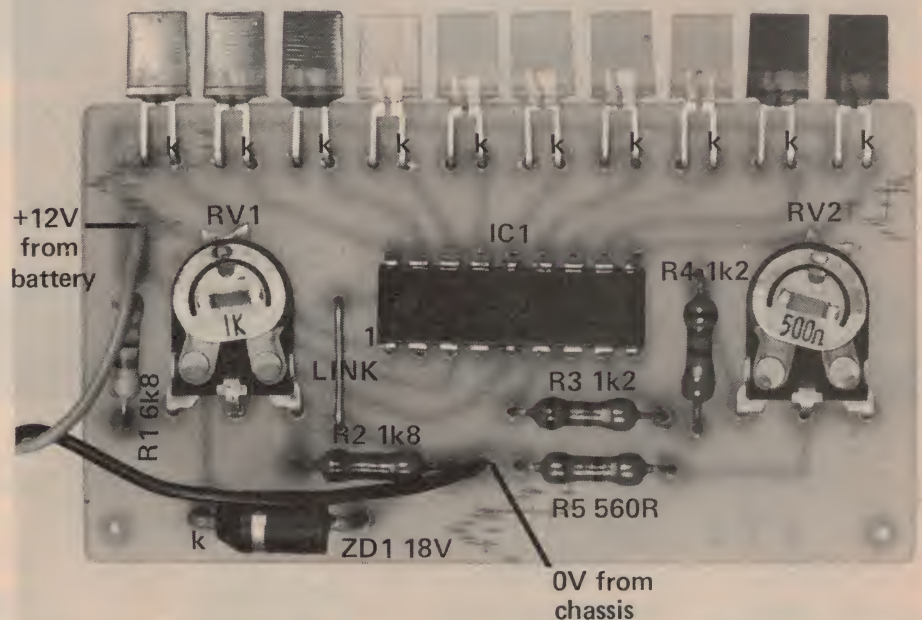
The positive supply lead to the instrument should be taken directly to the battery terminal, or the starter motor connection. This is to avoid any voltage drop in the vehicle's wiring from affect-



## PARTS LIST — ETI 326

<b>Resistors</b>	all 1/4W, 5%
R1	6k8
R2	1k8
R3,R4	1k2
R5	560R
<b>Trimpots</b>	
RV1	1k min. vert. mounting trimpot.
RV2	500 R min. vert. mounting trimpot.
<b>Semiconductors</b>	
ZD1	18V, 1W zener diode
LED1-LED3	red LEDs round or rect.
LED4-LED8	green LEDs round or rect.
LED9-LED10	red LEDs round or sq.
IC1	LM3914N
<b>Miscellaneous</b>	
	ETI-326 pc board; in-line fuse holder with 0.5 A fuse.

LED1 — LED10



ing the reading (such as in the headlight wiring). The chassis connection can be made to the car body under the dash, wherever convenient, or taken to a chassis connection point in the engine bay.

## Use in a vehicle

Say you get into your car in the morning. Before you start the engine, the unit will probably register in the upper range of the green portion of the scale. If you left the lights on overnight the

battery voltage will most likely be low. If below 11 volts, you'll probably have to push start the car.

Let's assume you've got the car going. As you drive off, the voltage should rise until it reaches the maximum charging voltage — about 14.0 to 14.5 volts.

When you reach your destination and switch off the engine the voltage should fall slightly — maybe 0.5 V - 1.0 V, to about 13.0 or 13.5 volts (LED6 or LED7 should light). The accompanying table may be used as a general guide to battery faults.

## THE LM3914 — HOW IT WORKS

The LM3914 is a highly versatile device designed to sense an analogue input voltage and drive a row of ten outputs, usually LEDs or other indicators, in either a 'dot' or 'bar' graph mode.

The IC contains a ten resistor potential divider. Ten voltage comparators in the chip each have their non-inverting (+) input connected to successive taps on the ten-resistor divider. All the inverting inputs of the comparators are tied together and are driven by the output of a buffer from the input. The buffer has unity overall gain, so that for all intents and purposes the voltage on the inverting inputs of the ten comparators is the same as that on the input pin (pin 5). The outputs of the comparators each go to an individual pin on the IC and are capable of driving an LED or other circuitry.

An internal reference voltage source provides a highly stable 1.2 volts between pins 7 and 8. Since this reference is 'floating', the voltage between pins 7 and 8 always remains at 1.2 volts, irrespective of whether pin 8 is tied to ground or held at some voltage above ground.

Finally, the IC also contains an internal logic network that can be externally programmed to provide either a 'dot' or 'bar' display from the outputs of the ten voltage comparators. When the dot mode is selected, only one of the ten outputs will be 'active' as the input voltage varies. When the bar mode is selected, each output becomes 'active' in succession as the input voltage increases, and vice versa.

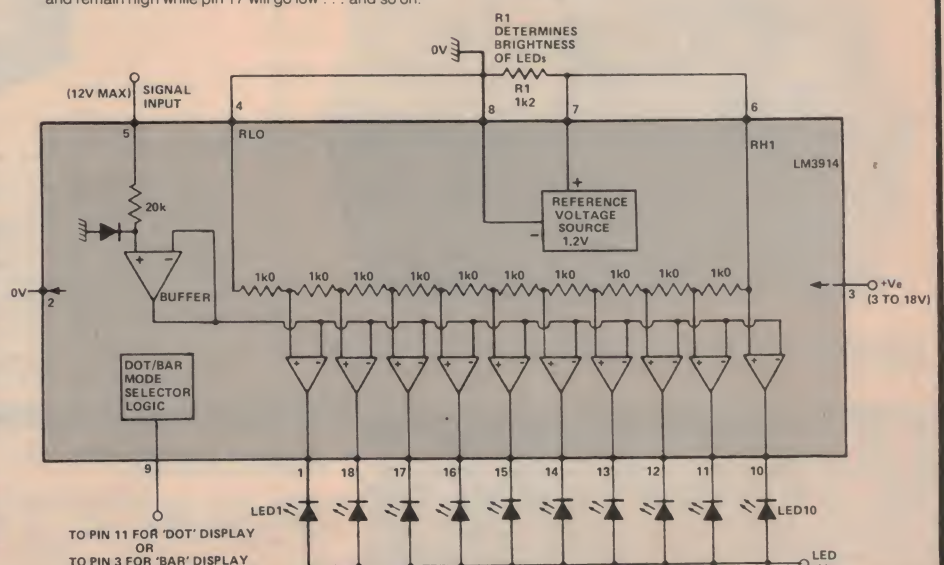
If the reference voltage (1.2 V) is connected across the internal resistive divider, by connecting pin 7 to pin 6 and pin 8 to pin 4, 0.12 volts is applied to the non-inverting input of the lowest voltage comparator, 0.24 V to the next 'up' the divider line, 0.36 V to the next, and so on.

When the input voltage on pin 5 is zero, all the comparator outputs are high. As the input voltage is increased, the buffer output will increase. When it passes 0.12 V, the first comparator in the string (output on pin 1) will switch and its output will go low and remain low. If the

input continues to rise, the next comparator will switch over and pin 18 will go low and remain low when the input passes 0.24 V. Pin 17 will go low and remain low when the input passes 0.36 V etc; pin 10 (output of the tenth comparator) will go low and remain low when the input reaches or exceeds 1.2 V. This is what happens when the bar mode is selected. For the dot mode, pin 1 will go low when the input reaches 0.12 V. When the input reaches 0.24 V, pin 1 will go high and remain high and pin 18 will go low. When the input reaches 0.36 V, pin 18 will go high and remain high while pin 17 will go low... and so on.

The output currents from the comparators may be programmed by a connecting resistor across the reference supply, between pins 7 and 8. Each comparator output current is approximately ten times the output current of the voltage reference source. This can supply about 3 mA maximum, so the maximum output current from each comparator is 30 mA.

A detailed explanation of the operation and applications of the LM3914 appeared in the March 1980 issue of ETI, page 61.





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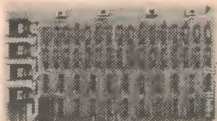
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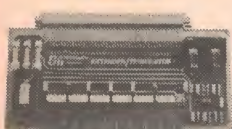
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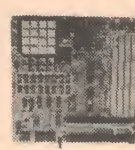
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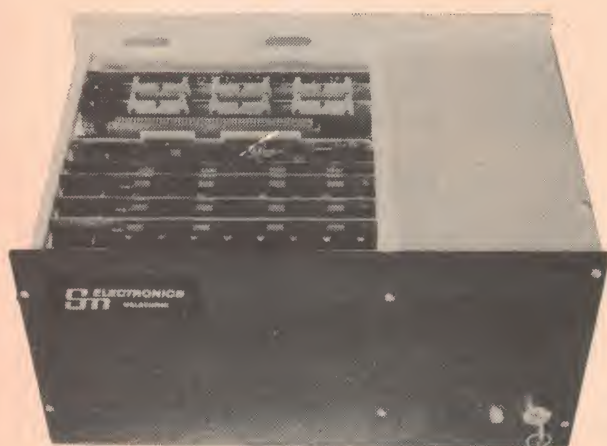
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## 'Magic candle' is a beaut party novelty

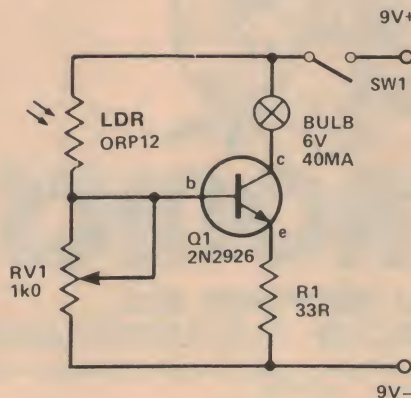
ELECTRONIC PARTY TRICKS are always popular. The majority of people have very little understanding of electronics and even simple tricks can mystify them. This circuit, a 'magic candle', uses only a handful of common components and can be built very quickly. However, as with many projects of this type, the ingenuity in building is probably more important than the circuitry. This however, is left to the reader, though some general tips are given later.

The idea of the magic candle is to demonstrate that light bulbs can be lit by a match or cigarette lighter and then 'snuffed' like a candle. The bulb should be the only item that is actually showing but it is important that the LDR — light dependant resistor — is very close by with the active face pointing at the bulb.

When a match is struck and brought up to the bulb this causes light to fall on the LDR. The resistance of the LDR then falls considerably and since this forms a potential divider with RV1, which is coupled to the base of the transistor, the voltage here rises and causes the transistor to conduct. This causes current to flow through the bulb which in turn lights up.

When the match is withdrawn, the light from the bulb takes over as the source which keeps the resistance of the LDR low and so the transistor will remain on and the bulb will stay alight. If now the bulb is 'snuffed' by breaking the path of light between the bulb and the LDR, the bulb will go out and remain so until the light level once again reaches a sufficient brightness to turn the transistor on.

The use of a 6 V bulb is simply because these types are widely available and cheap and in order to prevent too high a voltage being applied the resistor R1 is connected in the emitter circuit. In the conducting stage there is a small voltage drop across Q1 and about 1.5-2 V will be dropped across the resistor, thus ensuring that the bulb is not overdriven.



Since the circuit will have to operate in widely differing light levels, it is necessary to control the sensitivity of the circuit and this is accomplished by RV1. In high ambient light levels the value of RV1 should be low, this means that the transistor will remain switched off until the light level created by the match goes above this level. In low light levels the value of RV1 will be high.

RV1 can take the form of a miniature preset control which, for normal uses, can probably be left at some level found experimentally for general purpose use. It is not possible to give even an indication of this value as the resistance of light dependant resistors varies considerably with the individual unit.

The current drain of 40 mA is rather heavy for a PP3 battery, though one in good condition will work for a short period. The heavy current drain may be acceptable as the circuit is unlikely to be on for long periods and this battery has the advantage of being small in physical size and cheap.

The on-off switch can take any con-

venient form, it may even be omitted, the circuit being switched off by removing the battery clips.

As we mentioned before the bulb should be the only thing that observers can see, all the other components being hidden in a small box on which the bulb is mounted. An LDR is about 16 mm in diameter. This can be well disguised since the active surface is rather smaller and in any case not all of it has to be exposed, even a 6 mm diameter hole should be sufficient and this hole should be close to the bulb and pointing at it. It must of course be possible to easily interrupt the light path between the bulb and the LDR in order to 'snuff' the lamp.

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SHORT CIRCUITS is a feature that lies somewhere between Ideas for Experimenters and complete Projects. Generally, the items published in Short Circuits will involve tried circuits that have not necessarily been fully developed, but fairly complete details are included as a guide to readers. Unfortunately, owing to the nature of these items, we cannot give further details other than what is provided in the article. Contributions for Short Circuits are always welcome.





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TV sync-separator circuit  
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Cut the crackle and get rid of the rumble with our

## Scratch and rumble filter

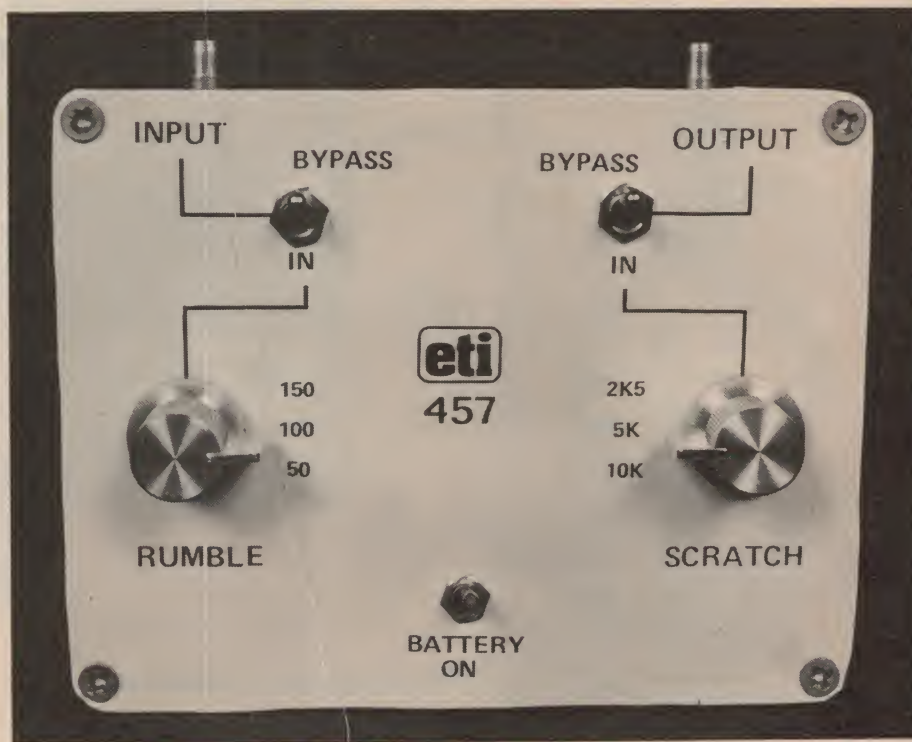
### Staff

If many of your cherished older recordings are showing signs of old age and long use, or if you wish to transcribe your collection of 78s onto tape, this scratch and rumble filter project should help improve the sound quality.

SO YOU SAY you look after your records, but you probably have some that are scratched? Perhaps you lent them to someone who didn't care for them or they might be cherished rarities you picked up in a secondhand shop. Some of the best 'original' recordings are still on 78s especially if you're into jazz, bluegrass, blues or country music. Whatever the cause, clicks, pops and severe surface noise can spoil your listening pleasure, no matter how enthusiastic you are about the artist or the item recorded.

One other source of unwanted sound comes from the turntable in the form of rumble — a low frequency sound which can make your teeth grind in sympathy! If you look at the speaker cone whilst playing a turntable suffering from rumble, you may see it move in and out, although you may not hear anything. This is subsonic rumble and can be detrimental to the performance of the speaker system. The main cause of rumble is a less than perfect turntable transmitting vibration from the motor and bearings to the stylus. Rumble has almost been cured with the introduction of belt drive and good direct-drive turntables but these can suffer from wow and flutter. That's another story, though. Low frequency acoustic feedback from the speakers to the turntable can also occur if the acoustic mounting of the turntable is not up to scratch.

The high frequency surface noise on a recording can be removed with a 'high cut' filter. This will also cut the highs on the recording but on old records this will not be so noticeable. Likewise, low frequency noise can be removed with a 'low cut' filter and again, some of the low frequency information is lost.



It is desirable to only modify enough of the amplifier's frequency response to reduce the problems, therefore we have included switchable cutoff frequencies for each filter. High frequency hiss can usually be removed with the 10 kHz filter while cracks will probably need a lower frequency cutoff.

The unit uses two active filters in series, one a low cut for the rumble filter, the other a high cut for the scratch filter. The filters provide an attenuation of 12 dB per octave at frequencies past the cutoff point and can be switched in

and out independently. The unit is battery operated and designed to go between the turntable and the preamplifier on older stereo systems, or between the preamplifier and the main amplifier on modern systems. We have built each channel on a separate pc board to allow the unit to be used for either mono or stereo systems. We have shown only one channel for simplicity. If you wish to build a stereo version you will need to duplicate all components except the switches and batteries, and of course, the box.



## PARTS LIST — ETI 457

Resistors	all 1/2W, 5%
R1	27k
R2	12k
R3	2k7
R4,R5	15k
R6	220k
R7,R8	4k7
R9	10k
R10	820R

## Capacitors

C1,C4 ..... 68n greencap  
C2,C5 ..... 100n greencap  
C3,C6,C9 ..... 220n greencap  
C7,C8,C16 ..... 1u tantalum  
C10,C13 ..... 10n greencap  
C11 ..... 22n greencap  
C12,C15 ..... 4n7 greencap  
C14 ..... 2n2 greencap

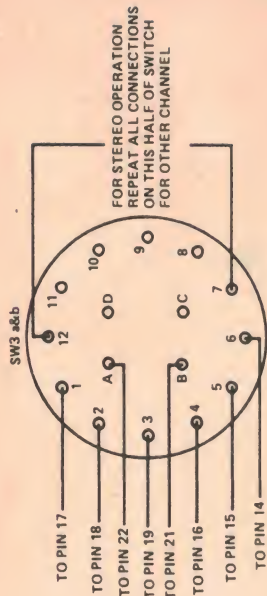
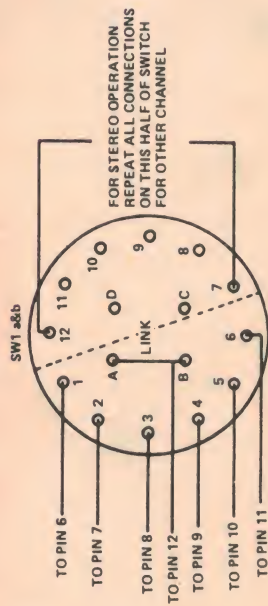
## Semiconductors

Q1,Q2 ..... BC549, BC109 or sim.  
LED1 ..... red LED TIL220R or sim.

## Miscellaneous

SW1, SW3 . . . . . four pole, three-way  
wafer switches  
SW2, SW4, SW5 . . . DPDT miniature toggle  
switches

ETI-457 pc board; two RCA phono sockets; box to suit (120 mm x 95 mm x 55 mm); knobs; 9V No. 216 battery and battery clip.

SW1 LOW CUT RANGES SW3 HIGH CUT RANGES

	10 kHz	5 kHz	2.5 kHz
1. 150 Hz			
2. 100 Hz			
3. 50 Hz			

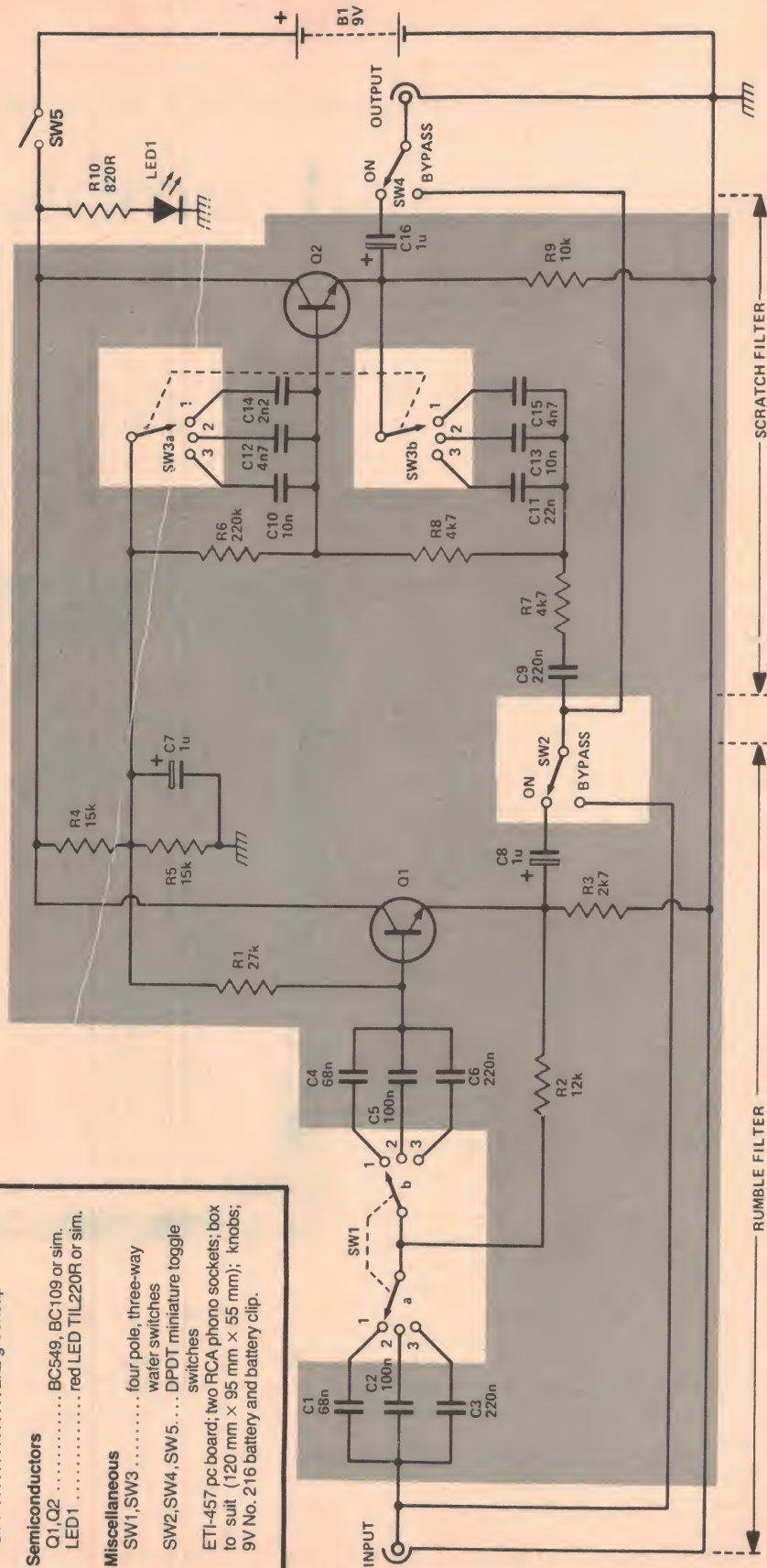
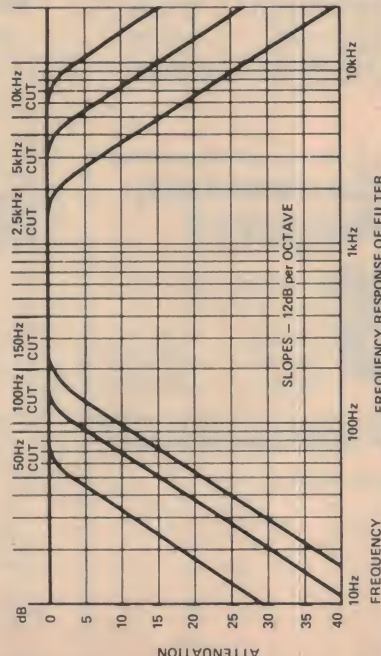




Figure 1 shows the block diagram of the mono version of the scratch and rumble filter. The input signal (from the turntable pick-up) is first fed through a high-pass filter, which rejects unwanted low-frequency rumble signals, and is then fed through a low-pass filter which rejects unwanted high-frequency scratch signals. Each filter can be bypassed via a simple switch if required, so the input signal can be passed through either one, both, or neither of the filters.

Figure 2 shows the circuit (a) and performance graph (b) of a simple single-stage passive high-pass filter. At low frequencies, capacitor C1 presents an impedance that is



high relative to R1 so a lot of signal attenuation occurs between the input and output terminals. At high frequencies C1 presents an impedance that is low relative to R1, so negligible signal attenuation occurs between input and output.

The frequency at which the output signal is 3 dB down on the input signal is conventionally known as the BREAK frequency.

Note in Figure 2(b) that the graph shows a smooth roll-off or slope up to the break frequency point: a single stage filter has a slope or roll off of 6 dB/octave, i.e. the signal output level doubles if the input frequency is doubled. A number of filter stages can be cascaded to

give a roll-off of greater than the basic 6 dB/octave: usually, some kind of electronic buffering or feedback is used between the individual sections of a multi-stage pass filter system.

Figure 3 shows the circuit (a) and performance graph (b) of a two-stage high-pass filter. This design is known as a Butterworth filter, and is the type used as the rumble filter section of our project: it has a sharp break frequency, and gives a slope or roll-off of 12 dB/octave.

The basic high-pass filter of Figure 2 can be made to act as a low-pass type by simply transposing the positions of C1 and R1, as

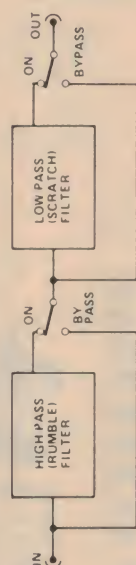


Figure 1. Block diagram, scratch and rumble filter.

Figure 2 (a). Simple passive high-pass filter.

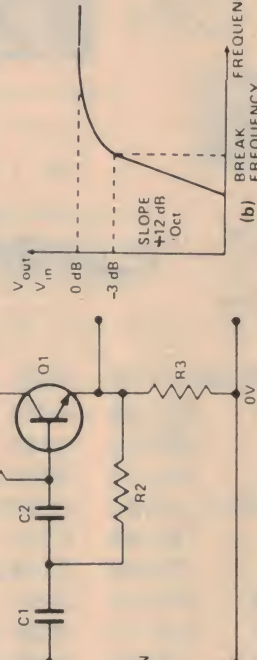


Figure 3 (a). Two-stage active high-pass filter. Figure 3 (b). Frequency response.

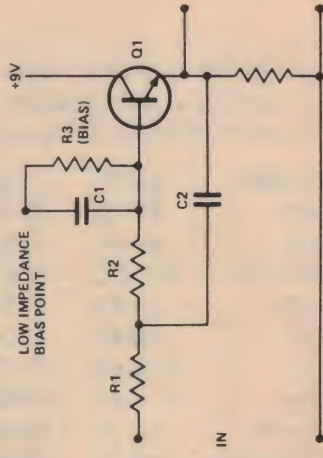


Figure 5 (a). Two-stage low-pass filter.

shown in Figure 4. Figure 5 shows the two-stage (second order) Butterworth version of the low-pass filter. This is the design that is used as the scratch filter in our project.

In the complete project (see main diagram) the high-pass or rumble filter is designed around Q1 and R1, R2 and C1 - C6, and the low-pass or scratch filter is designed around Q2 and R6 - R8 and C10 - C15. Resistors R4, R5 and bypass capacitor C7 provide the low-Z bias point for the two transistors. The low-frequency break point of the rumble filter can be varied via three-way switch S1, and the high-frequency break point of the scratch filter can be varied via S3.

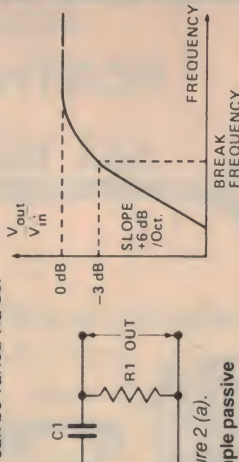


Figure 2 (b). Frequency response.

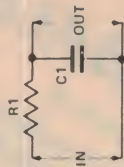


Figure 4 (a). Simple passive low-pass filter.

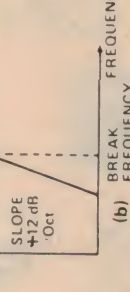


Figure 4 (b). Frequency response.

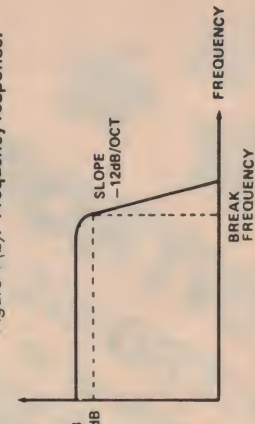
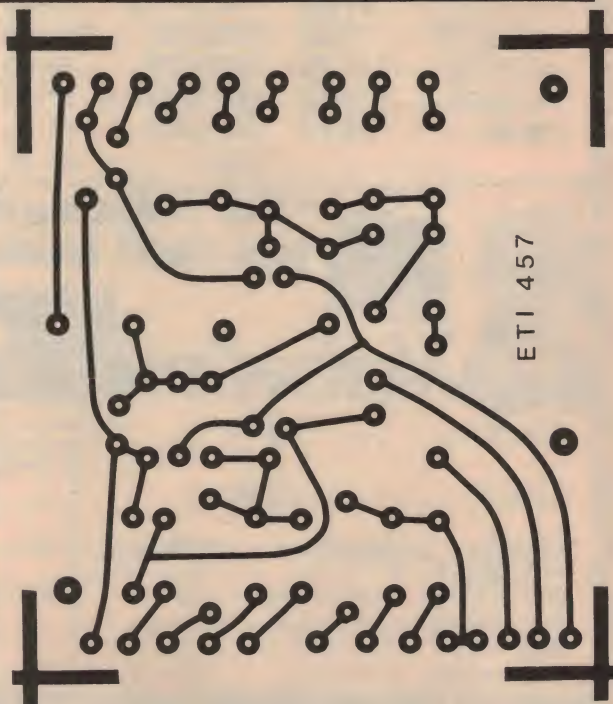


Figure 5 (b). Frequency response.





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## Construction

This description is confined to the mono version. A stereo version is readily assembled from two pc boards. As the switches are all available with a complete extra set of poles and contacts, these components need not be duplicated in a stereo version. Wiring will follow much the same course as described here.

We built our filter into a diecast box, but you may have something else in mind. A diecast box is very robust and provides generally good shielding, although a steel box would further reduce possible hum pickup.

All the switches are mounted on the lid of the diecast box. The pc board is 'hung' off the rotary switches and supported by tinned copper wire from the switch tags. This makes quite a rigid assembly and ensures short wiring to the switches. For a stereo version, the second channel pc board may be mounted behind the first, wired to the switches in a similar fashion.

The input and output sockets are mounted on one wall of the box and wired to the pc board with shielded cable. The bypass toggle switches are wired with hookup wire.

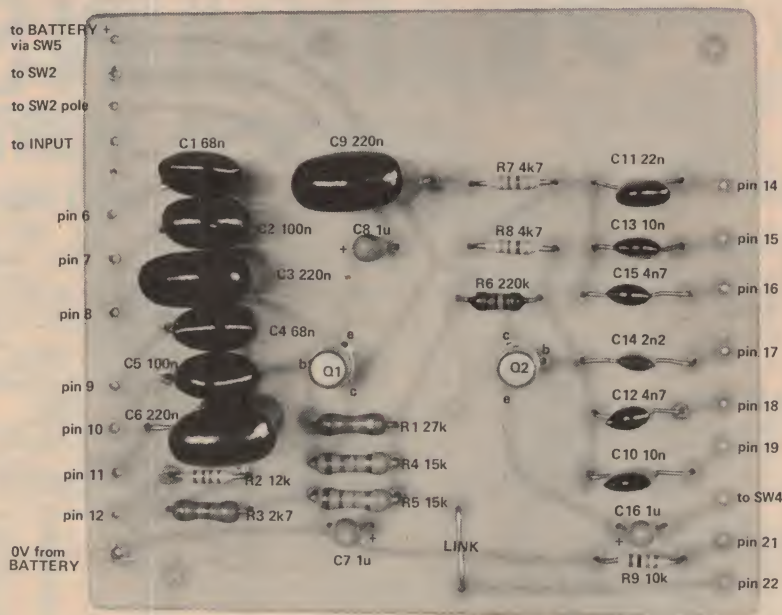
When assembling the pc board, watch out for the polarity of the tantalum capacitors and the orientation of the transistors, otherwise assembly is quite easy. With the components mounted in the board, the next step is to solder 50 mm lengths (longer for the second channel in a stereo version) of tinned copper wire to the lugs on the rotary switches.

Solder suitable lengths of insulated hookup wire to the points on the pc board that lead out to the toggle switches SW2, SW4 and SW5.

Carefully insert the tinned copper wires into their respective holes on the pc board and push the board up the wires to within about 15 mm or so of the switches. Take care not to bend any of the wires. Solder all the wires in place and cut off the excess. If building a stereo version, repeat this, taking care not to get the two channels' switch wiring tangled, pushing the second channel board to within 15 mm of the first.

Wire all the toggle switches input and output leads and you're ready to try it out.

We used a No.216 9 V battery. This is quite sufficient for the mono or stereo versions as current drain is only two milliamps per channel.



Component overlay for the pc board. Note that pin numbers 1 to 5, plus 13 and 20, are not used. Resistor R10 and the indicator LED1 are mounted off the pc board (we have not used these).

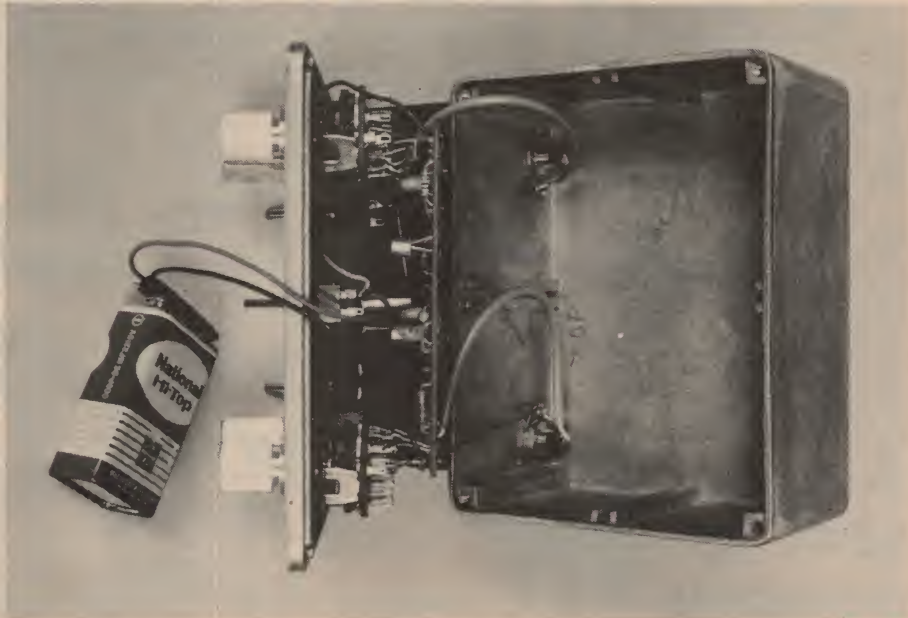
## Operation

Operation is quite simple. With the unit's switches set for bypass, put on a record known to suffer from surface noise problems. Switch the unit on and put the scratch filter in circuit. Adjust the rotary switch and note the effect of the different filter frequencies. Do the same for the rumble filter.

A little experimentation should show up the best setting for each recording. It's worthwhile keeping a note of the setting with each record. The Scratch and Rumble filter is also a great aid when making tape recordings of old discs, particularly 78s.

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Internal view of the completed project showing the location of the input and output RCA sockets and the pc board 'hung' from the rear of the switches. Note that this is a mono version.







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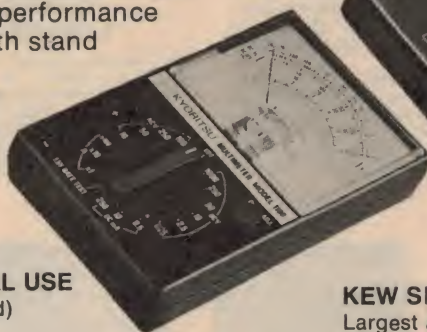


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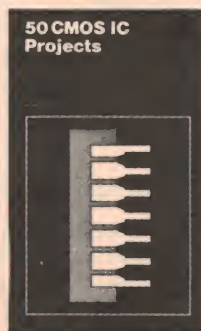
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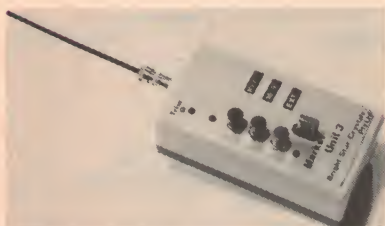
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# Lab Notes

## Using the 3080 IC

This remarkable IC is quite different to run-of-the-mill op-amps as it has a "control" pin that varies the device's transconductance as the current into this input is varied. These circuits illustrate various ways to use the device — from an original manuscript by UK correspondent, Tim Orr.

THE CA3080 IS KNOWN as an *operational transconductance amplifier* (OTA). This is a type of op-amp, the gain of which can be varied by means of a control current, ( $I_{ABC}$ ). The device has a differential input, a control input known as the 'amplifier bias input' and a current output. It differs in many respects from conventional op-amps and it is these differences that can be used to realise many useful circuit blocks.

### Voltage controlled amplifier

The CA3080 can be used as a gain controlling device. A useful circuit is shown in Figure 1. The input signal is attenuated by R1, R2 such that a 20 mV peak-to-peak signal is applied to the input terminals. If this voltage is much larger, then significant distortion will occur at the output. In fact, this distortion is put to good use in the triangle-to-sinewave converter. (Figure 3, but we're jumping the gun).

The gain of the circuit is controlled by the magnitude of the current  $I_{ABC}$ . This current flows into the CA3080 at pin 5, which is held at one diode voltage drop above the  $-V_{CC}$  rail. If you connect pin 5 to 0 V, then this diode will get zapped (and so will the IC!). The maximum value of  $I_{ABC}$  permitted is 1 mA and the device is 'linear' over four decades of this current. That is, the gain of the CA3080 is 'linearly' proportional to the magnitude of the  $I_{ABC}$  current over a range of 0.1  $\mu$ A to 1 mA. Thus, by controlling  $I_{ABC}$ , we can control the signal level at the output.

The output is a current output which has to be 'dumped' into a resistive load (R5) to produce a voltage output. The output impedance seen at IC1 pin 6 is 10k ( $R_5$ ), but this is 'unloaded' by the voltage follower (IC2) to produce a low output impedance.

The circuit involving IC3 is a precision voltage-to-current converter and this can be used to generate  $I_{ABC}$ . When  $V_{in}$  (control) is positive, it linearly

controls the gain of the circuit. When it is negative,  $I_{ABC}$  is zero and so the gain is zero.

This type of circuit is known by several names. It is a *voltage controlled amplifier*, (VCA), or an *amplitude modulator*, or a *two quadrant multiplier*.

One problem that occurs with the CA3080 is that of the 'input offset voltage'. This is a small voltage diffe-

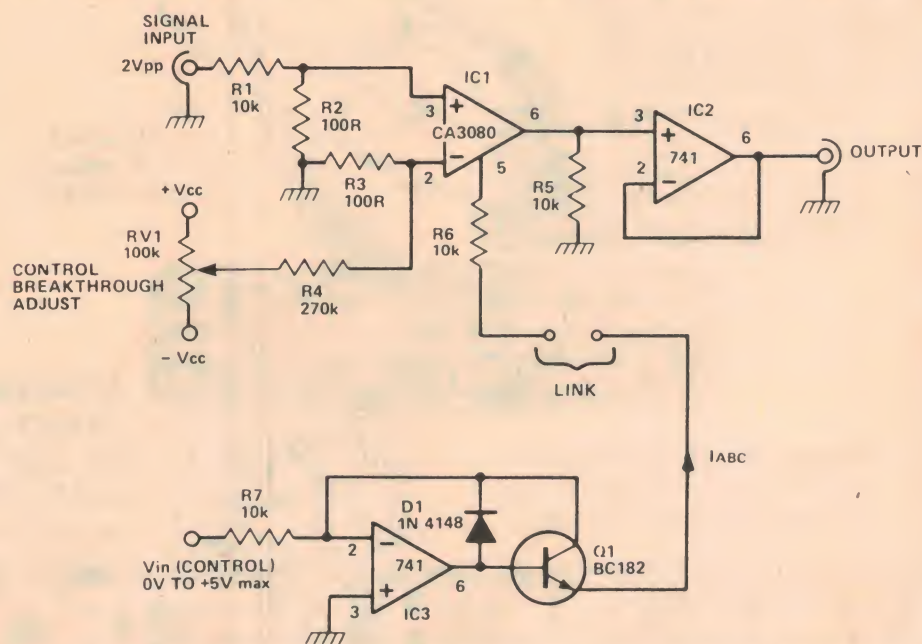


Figure 1. A voltage controlled amplifier. Gain is varied by varying RV1. You can modulate a signal passing through the amplifier by joining the 'link' and applying a modulating signal to the input of IC3 (at R7). This sort of circuit is also known as a 'two quadrant multiplier'.



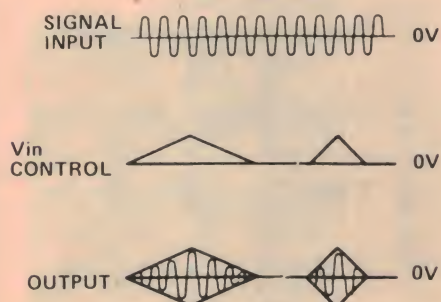


Figure 2. Illustrating the operation of the voltage controlled amplifier shown in Figure 1.

rence, or 'offset', between its input terminals. When there is no signal input and the control input is varied, a voltage similar to the control input will appear at the output. By adjusting RV1 it is possible to null out most of this control breakthrough.

The effect of modulating  $V_{in}$  (control) is illustrated in Figure 2.

## Triangle to sinewave converter

By overloading the input of a CA3080 it is possible to produce a 'sinusoidal' transfer function. That is, if a triangle waveform of the correct magnitude is applied to the CA3080 input, the output will be distorted in such a way as to produce a sinewave approximation.

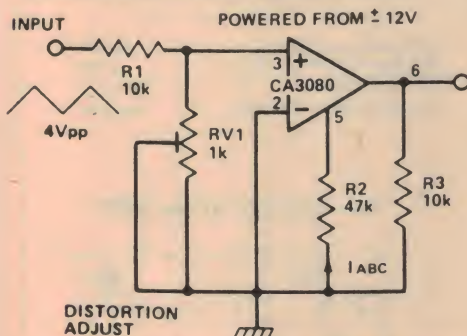


Figure 3. This circuit will convert a triangle wave to a sinewave with a resultant distortion of around 1.8%.

In the circuit shown (Figure 3), RV1 is adjusted so that the output waveform resembles a sinewave. I tested this circuit using an automatic distortion analyser and found the sinewave distortion to be only 1.8%, mostly third harmonic distortion which, for such a simple arrangement, seems very reasonable indeed. This could be used to produce a sinewave output from a triangle/square wave oscillator.

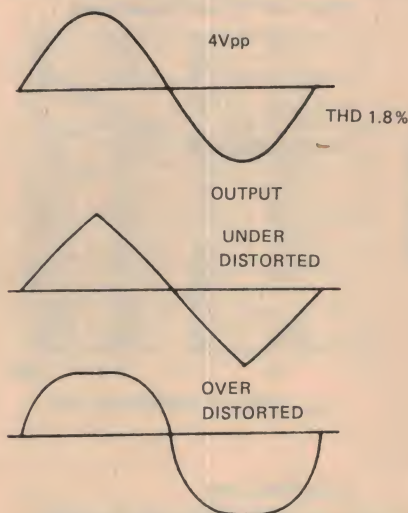


Figure 4. The output of the Figure 3 circuit should be adjusted (by RV1) to produce the waveform shown at top.

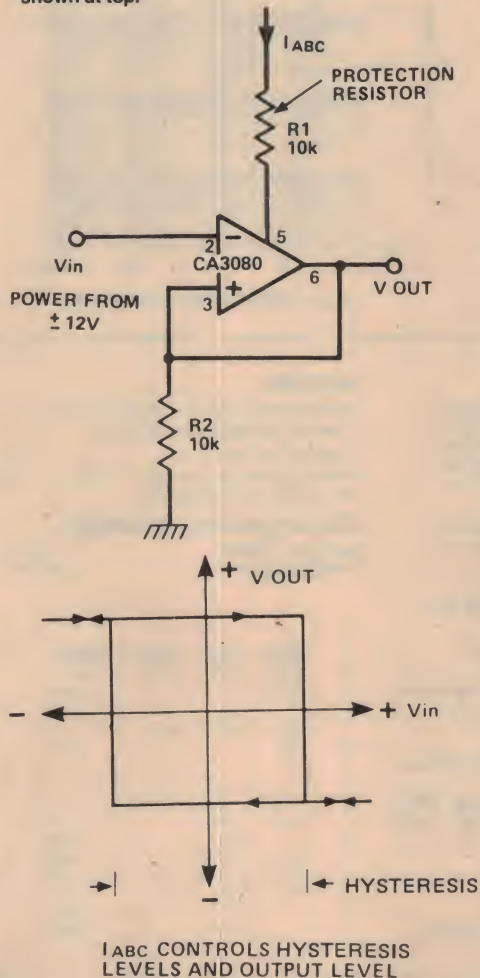


Figure 6. This sort of Schmitt trigger is not only simple but you can specify the hysteresis levels as well!

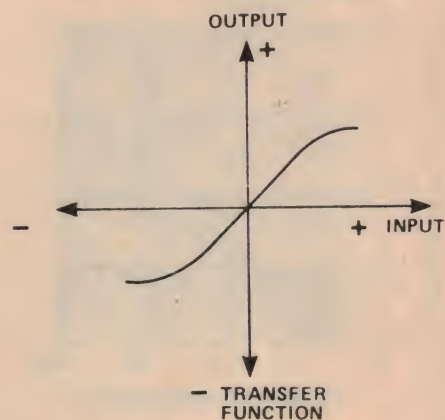


Figure 5. Transfer function of the Figure 3 circuit.

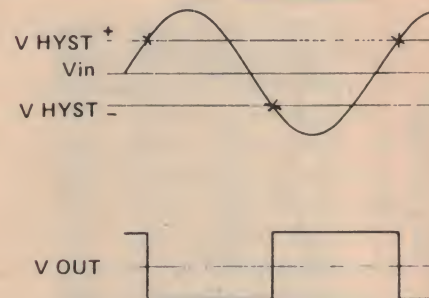


Figure 7. How the Schmitt trigger of Figure 6 works.

The result of varying RV1 is illustrated in Figure 4 and the transfer function of the circuit is shown in Figure 5.

## Schmitt trigger

Most Schmitt trigger circuits prove to be very complicated when it comes to calculating the hysteresis levels. However, by using the CA3080 these calculations are rendered trivial, plus there is the added bonus of fast operation. The hysteresis levels are calculated from the simple equation,

$$V_{HYST} = \pm (I_{ABC} \times R2)$$

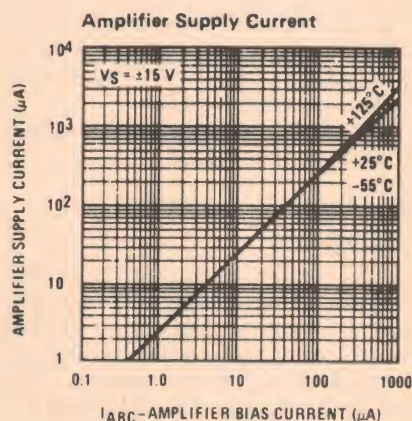
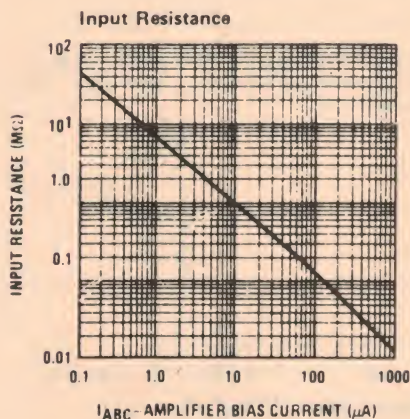
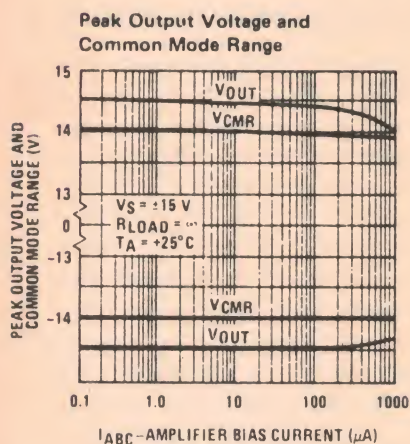
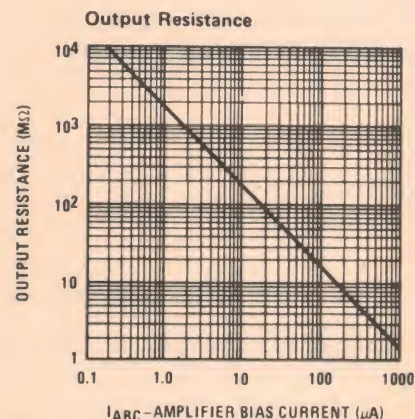
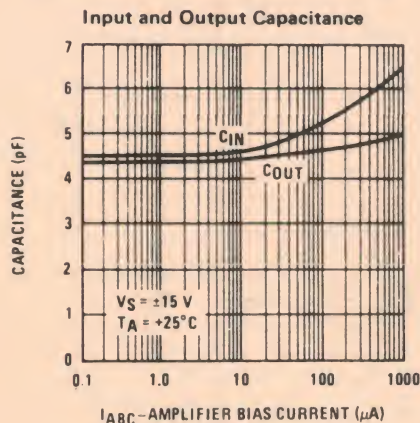
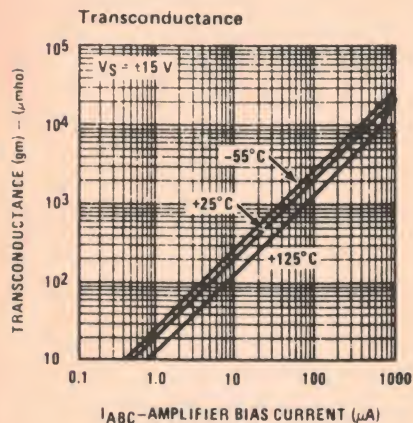
The output squarewave level is in fact equal in magnitude to the hysteresis levels. The circuit operation is as follows (referring to Figure 7):

Imagine the output voltage is high. The output voltage will then be equal to  $(R2 \times I_{ABC})$  which we will call  $+V_{HYST}$ . If  $V_{IN}$  becomes more positive than  $+V_{HYST}$ , the output will start to move in a negative direction, which will increase the voltage between the input terminals which will further accelerate the speed of the output movement. This



# Lab Notes

## SELECTED DATA ON THE 3080



### General description

The 3080 is a programmable transconductance block intended to fulfill a wide variety of variable gain applications. The 3080 has differential inputs and high impedance push-pull outputs. The device has high input impedance and its transconductance (gm) is directly proportional to the amplifier bias current ( $I_{ABC}$ ).

High slew rate together with programmable gain make the 3080 an ideal choice for variable gain applications such as sample and hold, multiplexing, filtering, and multiplying.

### Electrical characteristics, 3080 (Note 1).

#### Parameter

Forward Transconductance (gm)

Peak Output Current

Peak Output Voltage

Positive

Negative

Amplifier Supply Current

Common Mode Rejection Ratio

Common Mode Range

Input Resistance

Open Loop Bandwidth

Slew Rate

#### Conditions

Over Specified Temp. Range

$R_L = 0$ ,  $I_{ABC} = 50\mu\text{A}$

$R_L = 0$

$R_L = 0$

Over Specified Temp. Range

$R_L = .5\mu\text{A}$ ,  $I_{ABC} = 500\mu\text{A}$

$R_L = .5\mu\text{A}$ ,  $I_{ABC} = 500\mu\text{A}$

Unity Gain Compensated

### Features

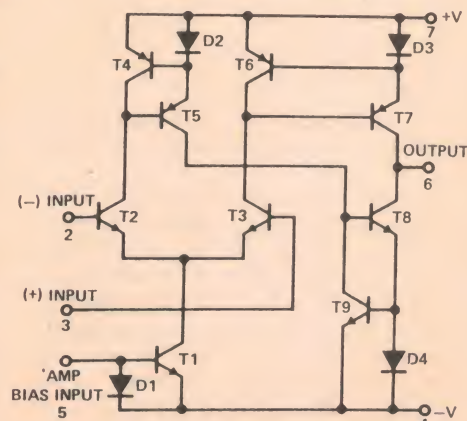
- Slow rate (unity gain compensated): 50 V/us
- Fully adjustable gain: 0 to gm  $R_L$  limit
- Extended gm linearity
- Flexible supply voltage range:  $\pm 2\text{ V}$  to  $\pm 18\text{ V}$
- Adjustable power consumption

### Absolute maximum ratings

Supply Voltage 3080  $\pm 18\text{ V}$   
Power Dissipation 250 mW

Differential Input Voltage  $\pm 15\text{ V}$   
Amplifier Bias Current ( $I_{ABC}$ ) 2 mA  
DC Input Voltage  $+V_S$  to  $-V_S$   
Output Short Circuit Duration Indefinite

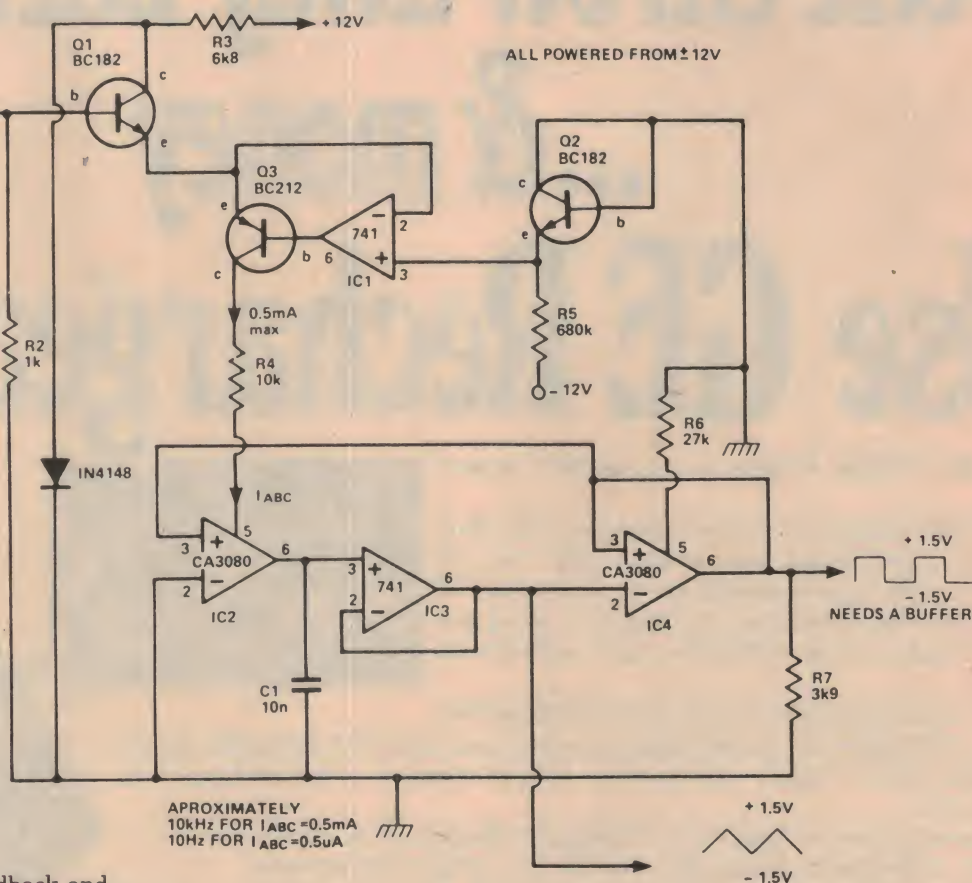
### Internal circuit of the 3080



**Note 1:** These specifications apply for  $V_S = \pm 15\text{ V}$  and  $T_A = 25^\circ\text{C}$ , amplifier bias current ( $I_{ABC}$ ) = 500uA, unless otherwise specified.



Figure 8. This voltage controlled oscillator has a square and a triangle output. By varying the input between  $-5\text{ V}$  and  $+5\text{ V}$ , the output frequency can be varied over the range  $10\text{ Hz}$  to  $10\text{ kHz}$ . Note that Q1 and Q2 should be a matched pair.



is known as regenerative feedback and is responsible for the Schmitt trigger action. The output snaps into a negative state at a voltage equal to  $-(R2 \times I_{ABC})$  which is designated as  $-V_{HYST}$ . Only when  $V_{IN}$  becomes more negative than  $-V_{HYST}$  will the output change back to the  $+V_{HYST}$  state.

The Schmitt trigger is a very useful building block for detecting two discrete voltage levels and finds many uses in circuit designs.

### Voltage controlled oscillator

By using two CA3080s and some 741 op-amps it is possible to make an oscillator, the frequency of which is voltage controllable. This unit finds many applications in the fields of electronic music production and test equipment.

The circuit (Figure 8) has been given a logarithmic control law, that is, the frequency of operation doubles for every volt increase in the control voltage. This makes it ideal for musical applications where linear control voltages need to be converted into musical intervals (which are logarithmically spaced) and also for audio testing where frequencies are generally measured as logarithmic functions.

One CA3080, IC2, is an integrator. The  $I_{ABC}$  current that drives this IC is used to either charge or discharge C1. This produces triangular waveforms which are buffered by IC3, which then drives the Schmitt trigger IC4. The hysteresis levels for this device are fixed at  $\pm 1.5\text{ V}$ , being determined by R6 and R7.

The output of the Schmitt trigger is fed back in such a way as to control the direction of motion of the integrator's output. If the Schmitt output is high, then the integrator will ramp upwards and vice versa.

Imagine that the integrator is ramping upwards. When the integrator's output reaches the upper hysteresis level, the Schmitt will flip into its low state, and the integrator will start to ramp downwards. When it reaches the low hysteresis level the Schmitt will flip back into its high state. Thus the integrator ramps up and down in between the two hysteresis levels.

The speed at which it does this, and hence the oscillating frequency, is determined by the value of  $I_{ABC}$  for IC2.

The larger the current, the faster the capacitor is charged and discharged.

Two outputs are produced, a triangle wave (buffered) from IC3 and a square-wave (unbuffered) from IC4. If the squarewave output is loaded, then the oscillation frequency will change so a buffer is advisable.

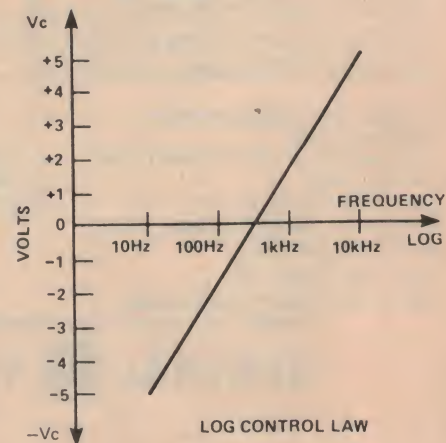


Figure 9. Voltage versus frequency characteristic of the Figure 9 circuit.



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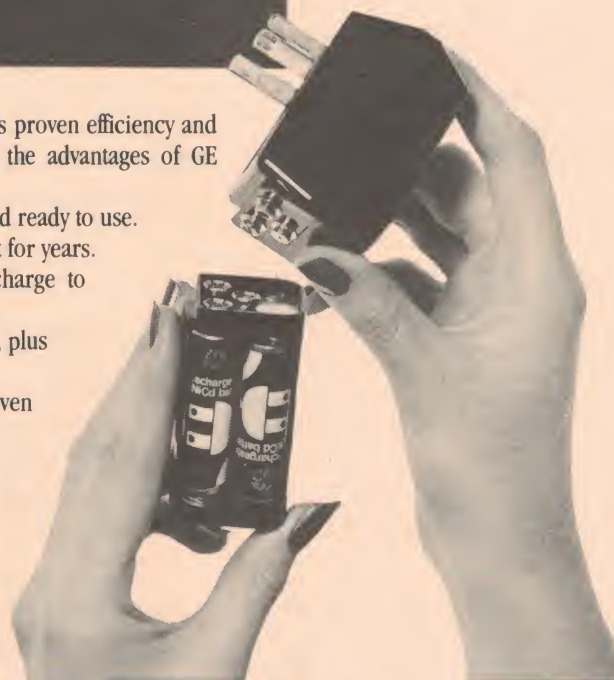
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The log. law generator is composed of Q1, 2, 3 and IC1. Transistors Q1 and Q2 should be matched so that their base emitter voltages ( $V_{be}$ ) are the same for the same emitter current, (50 $\mu$ A). Matching these devices to within 5 mV is satisfactory, although unmatched pairs could be used. When matching transistors, take care not to touch them with your fingers. This will heat them up and produce erroneous measurements.

Transistor Q2 is used to produce a reference voltage of about  $-0.6\text{ V}$ , which is connected to IC1 pin 3. This op-amp and Q3 is used to keep the emitter of Q1 at the same voltage of  $-0.6\text{ V}$ . The input control voltage is attenuated by R1, R2 such that a  $+1\text{ V}$  increase at the input produces a change of only  $+18\text{ mV}$  at the base of Q1. However, the emitter of Q1 is fixed at  $-0.6\text{ V}$ , so the current through Q1 doubles. (It is a property of transistors that the collector current doubles for every  $18\text{ mV}$  increase in  $V_{be}$ ).

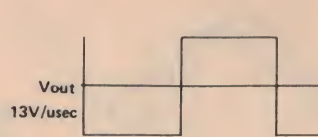
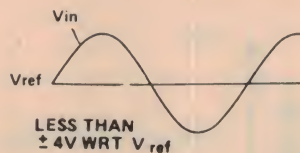
The emitter current of Q1 flows through Q3 and into IC2, thus controlling the oscillator frequency. It is possible to get a control range of over 1000 to 1 using this circuit. With the values shown, operation from 10 Hz to 10 kHz is achieved. Reducing C1 to 1n will increase the maximum frequency to 100 kHz, although the waveform quality may be somewhat degraded.

Changing C1 to 1uF (non-polarised) will give a minimum frequency of 0.1 Hz.

## Fast comparator

The high slew rate of the CA3080 makes it an excellent fast voltage comparator and a circuit is shown in Figure 10. When pin 2 of IC1 is more positive than  $V_{ref}$ , the output of IC1 goes negative and vice versa.  $V_{ref}$  can be moved around so that the point at which the output changes can be varied. As long as the input sinewave level is quite large (1 V say) then the output can be made to move at very fast rates indeed. However, care must be taken to avoid overloading the inputs. If the differential input voltage exceeds 5 V, then the input stage breaks down and may cause an undesired output to occur.

One use of a fast comparator is in a *tone burst generator*. A circuit is shown in Figure 11. This device produces bursts of sinewaves, the burst starting



and finishing on axis crossings of the sinusoid. The CA3080 is configured here as a voltage comparator, used to detect these axis crossings and to produce a square wave output which then drives a binary divider (IC3). The divider produces a 'divide by sixteen' output which is high for eight sinewave cycles and then low for the next eight. This signal is then used to gate ON and OFF the sinewave.

The gate mechanism is a pair of transistors which short the sinewave to ground when the divider output is high and let it pass when the divider output is low. The resulting output is a toneburst.

However, if the comparator is not ►

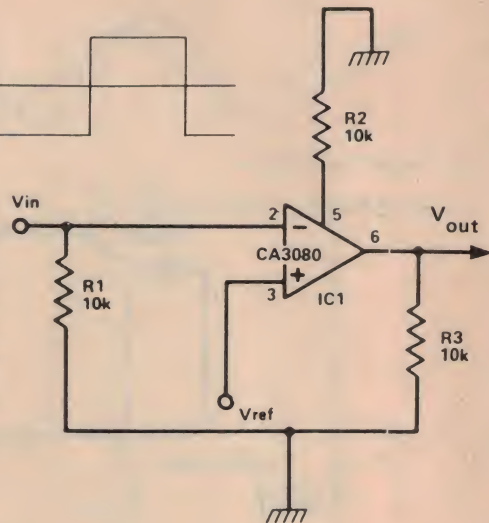
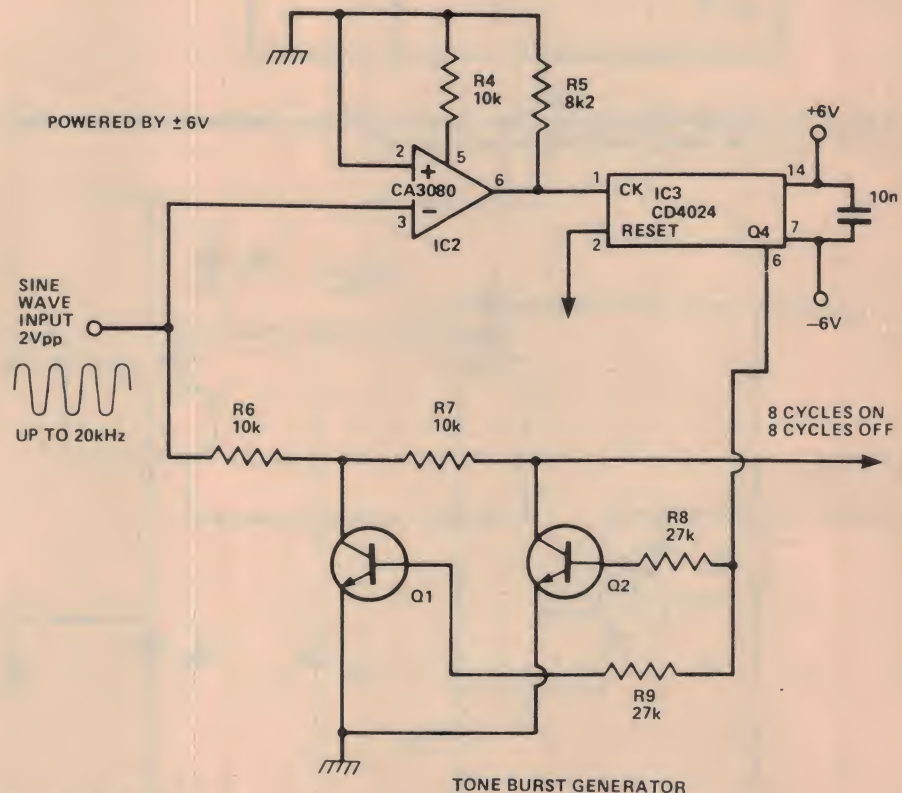
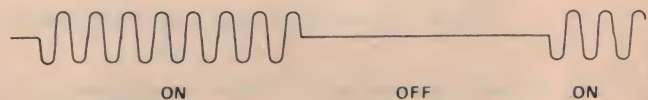


Figure 10. Example of a fast comparator.



**Figure 11. A fast comparator is used in this tone burst generator, producing eight cycles of tone with eight cycle breaks starting and finishing at on-axis crossings.**





# Lab Notes

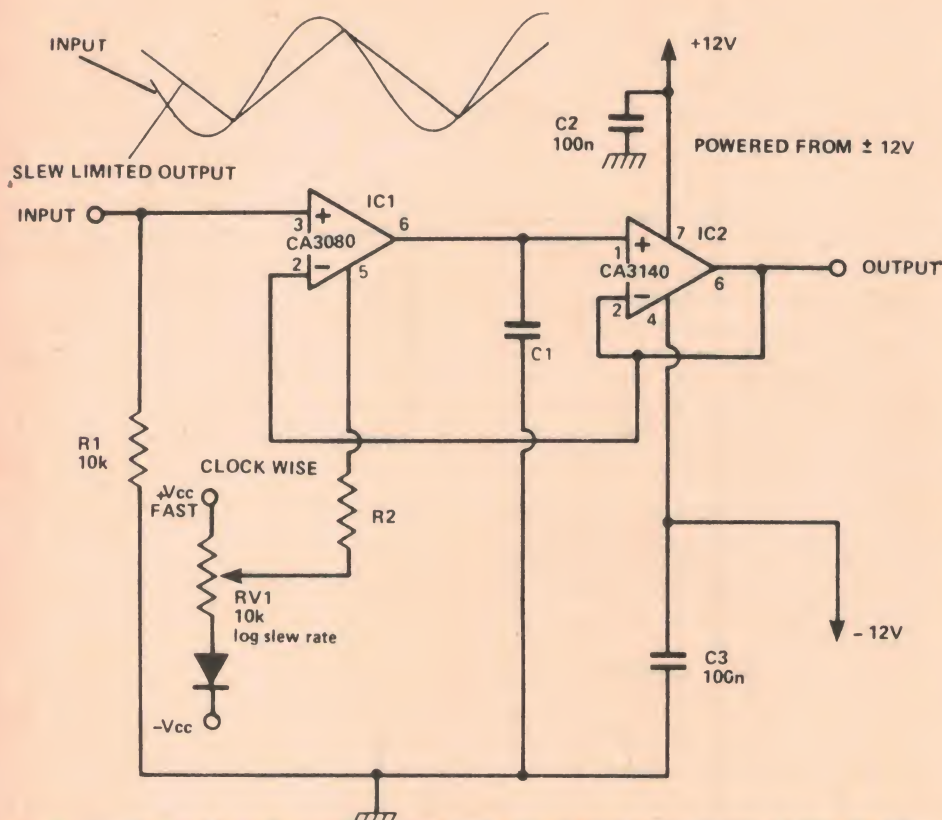


Figure 12. This slew rate limiter circuit produces a linear ramp on signals which exceed the slew rate limit, the output amplitude stopping when it reaches the signal level.

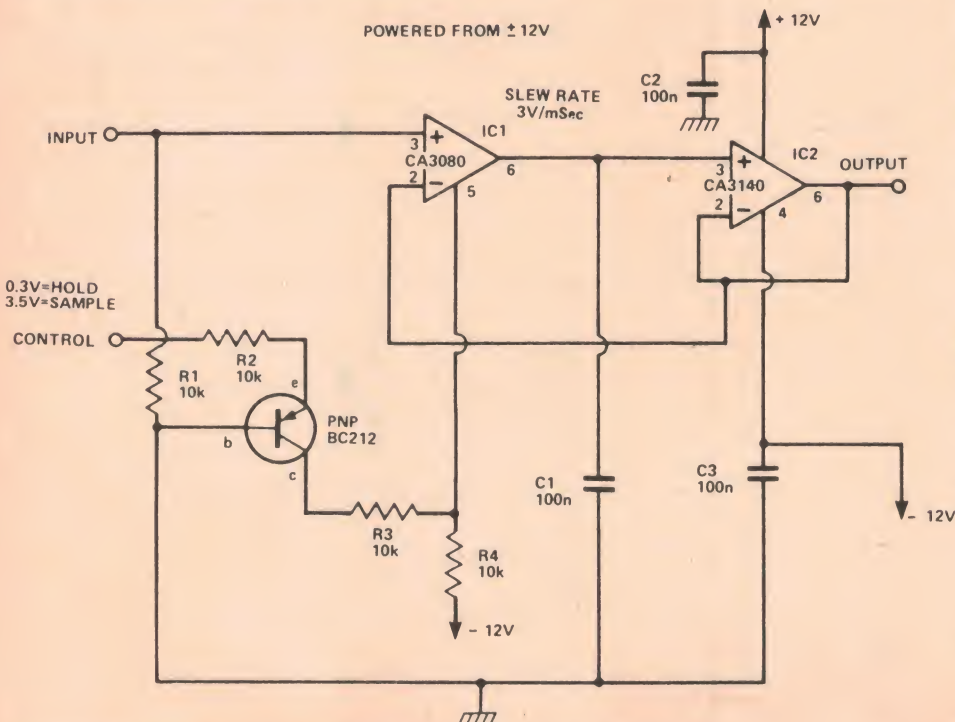


Figure 13. A typical application of the slew rate limiter is this sample and hold circuit.

very fast then there will be a delay in generating the gate and so the tone burst will not start or finish on axis crossings.

Using the circuit shown, operation up to 20 kHz is obtainable.

## Slew limiter

The current output of a CA3080 can be used to produce a controlled slew limiter. By connecting the output current to a capacitor, the output voltage cannot move faster than a rate given by

$$\text{Slew Rate} = \frac{I_{ABC}}{C1} \text{ Volts per sec.}$$

Note that  $I_{ABC}$  determines the slew rate and as  $I_{ABC}$  is a variable then so is the slew rate.

A suitable circuit is shown in Figure 12. The output voltage is buffered by a voltage follower, IC2. This is a MOSFET op-amp which has a very high input impedance, which is necessary to minimise the loading on C1.

When an input signal is applied to IC1 the output tries to move towards this voltage but its speed is limited by the slew rate. Thus, the output produces a linear ramp which stops when it reaches the input signal level.

## Sample and hold

A typical application of the slew limiter circuit is in a *sample and hold* circuit. The circuit in Figure 13 could be termed an analogue memory. When the control voltage is high, the circuit will 'remember' or 'hold' the input voltage level present at the time. The result is shown in Figure 14.

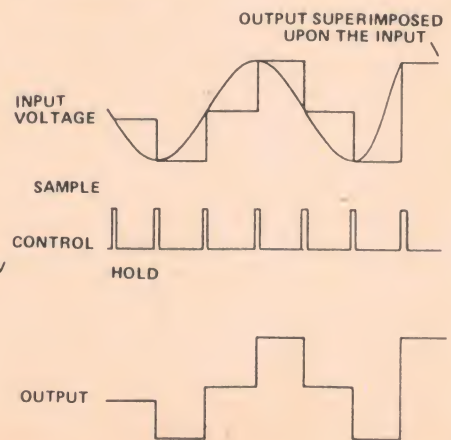
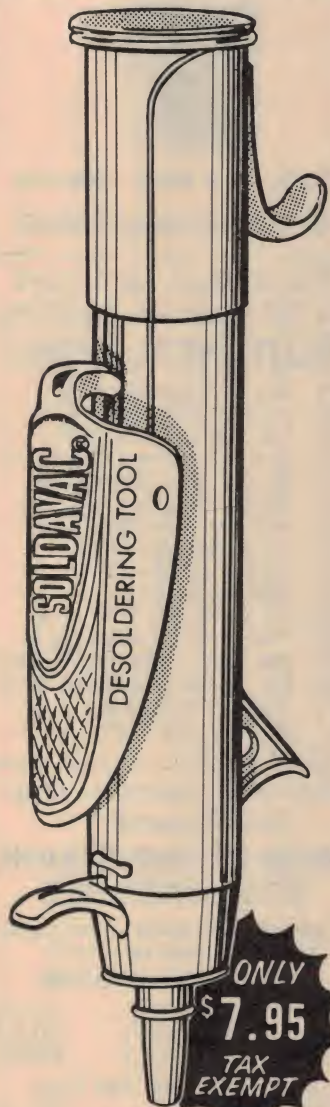


Figure 14. Illustrating the operation of the sample and hold circuit of Figure 13.



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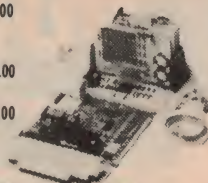
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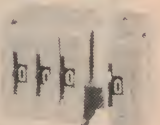
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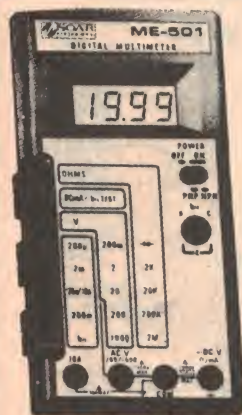
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# Lab Notes

In this circuit,  $I_{ABC}$  is either hard ON (sample) or completely OFF (hold). In the sample mode, the output voltage quickly adjusts itself so that it equals the input voltage. This enables a short sample period to be used.

In the HOLD mode,  $I_{ABC}$  is zero and so the voltage on C1 should remain fixed.

Such circuits are used in music synthesizers (to remember the pitch), in analogue-to-digital converters and many other applications.

## A multiplier/modulator

The CA3080 is basically a two-quadrant multiplier, that is, it has two inputs, one of which can accept bipolar signals (positive and negative going) — the inverting or the non-inverting input — the other can only accept a unipolar signal — the control input, pin 5.

Whilst a two-quadrant multiplier is very useful in a wide variety of applications, a four-quadrant multiplier has extra advantages. For example, apart from amplitude modulation, it can perform frequency doubling and ring modulation. See Figure 16. Now, a four-quadrant multiplier has two inputs, both of which can accept bipolar signals. An example of a four-quadrant multiplier is a frequency converter in a radio receiver. The familiar diode ring mixer is another example of a four-quadrant multiplier.

The circuit in Figure 15 is fairly similar to that of the two-quadrant multiplier shown in Figure 1. This circuit has several important differences.

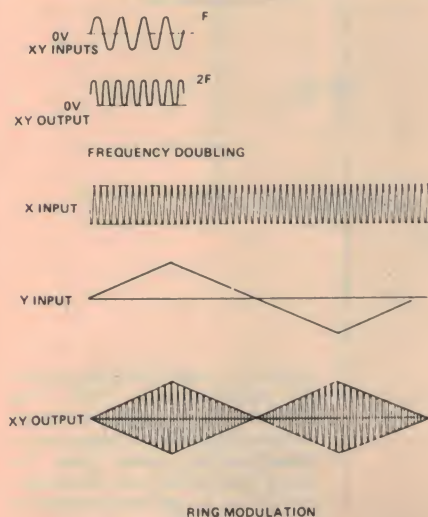


Figure 16. Illustrating the various operations of the four quadrant multiplier of Figure 15.

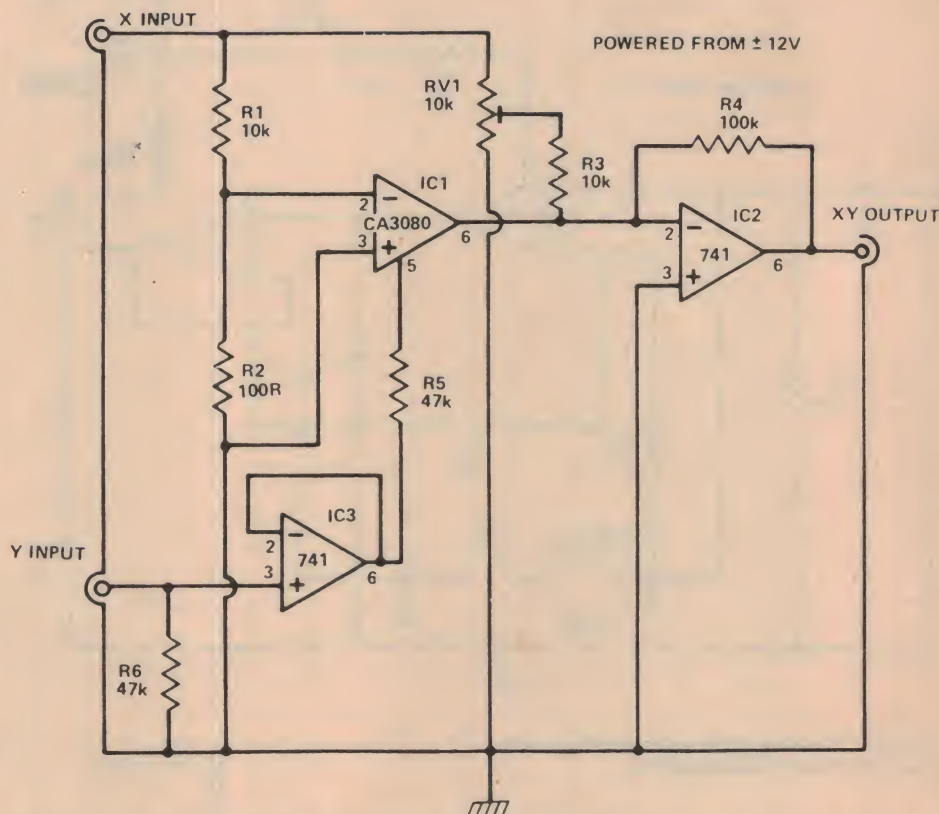


Figure 15. This multiplier/modulator can be used to produce a 'Dalek' voice when working as a ring modulator. It can also be used as a frequency doubler.

A 741 op-amp, IC3, is used to generate  $I_{ABC}$  in such a way that its input, the 'Y' input, can go both positive and negative. Thus, the Y input is bipolar.

When Y is at zero volts (no input) and there is a signal on the X input the desired output ( $X \times Y$ ) should be zero. This is achieved by adjusting RV1 so that the signal via IC1 (this is inverted) is exactly cancelled out by that via R3. Now, when Y is increased positively, a non-inverted value of X is produced at the output and, when Y is increased negatively, an inverted value of X is produced. When Y is zero, so is the output. This is known sometimes as ring modulation.

If a speech signal is connected to the X input and an audio oscillator to the Y input, the resulting sound is that of a 'Dalek'.

Also, if a sine wave is connected to both the X and Y inputs, the XY product is a sine wave of twice the frequency. This is known as a frequency doubler, but it will only work with sine waves.

For more theoretical information on four-quadrant multipliers, especially the variable transconductance type, see

"Operational Amplifiers" (second edition), by G.B. Clayton, published by Newnes-Butterworths and available in Australia through Butterworths, 586 Pacific Highway, Chatswood NSW 2067. (02)412-3444.

## Single pole filter/wah wah

The guitar 'wah wah' effects unit employs a filter which can be manually 'swept' across the middle of the audio frequency range, generally from around 500 Hz to 5 kHz or so, producing the peculiar 'wah wah' sound.

A single pole, voltage-controlled, low pass filter can be constructed using a CA3080 as a current-controlled resistor. The circuit is shown in Figure 17.

A simple, low pass RC filter configuration is employed, the controllable 'R' is the CA3080 and the 'C' is C1. Varying  $I_{ABC}$  varies the amount of current drive to C1. This circuit configuration would normally be a slew limiter, except that the signal level to the input of the CA3080 is kept deliberately low (R1 and R2 form a 100:1 attenuator) so that the IC operates in its linear mode. This enables it to look like a variable resistor. ▶



# Lab Notes

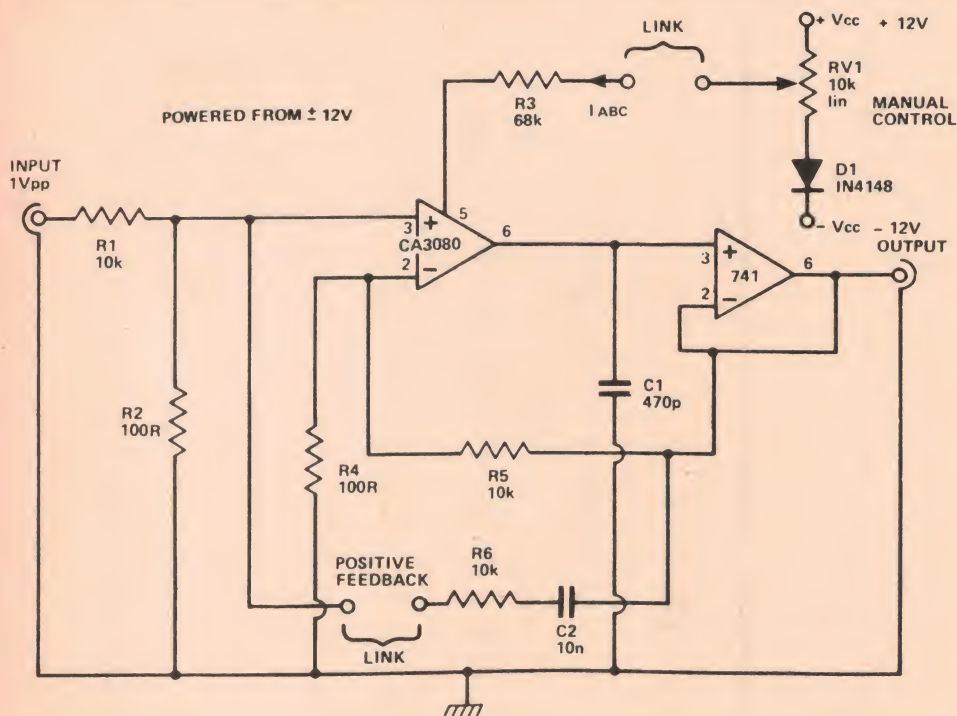


Figure 17. A guitar wah-wah unit can be made with a swept frequency single pole filter.

When this resistor is varied, the break frequency of the filter also varies.

By applying some positive feedback around the filter (R6, C2) it is possible to produce a peaky filter response. The peak actually increases with frequency, producing the wah wah effect.

The circuit as shown can be swept from about 400 Hz at the lower extreme to about 4 kHz at the upper extreme. See Figure 18.

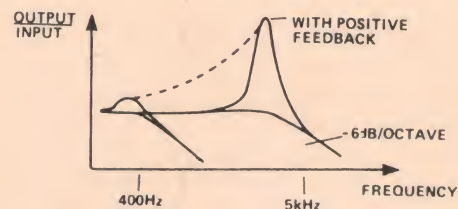


Figure 18. How the single pole filter affects the frequency response of the signal passed through the wah wah unit.

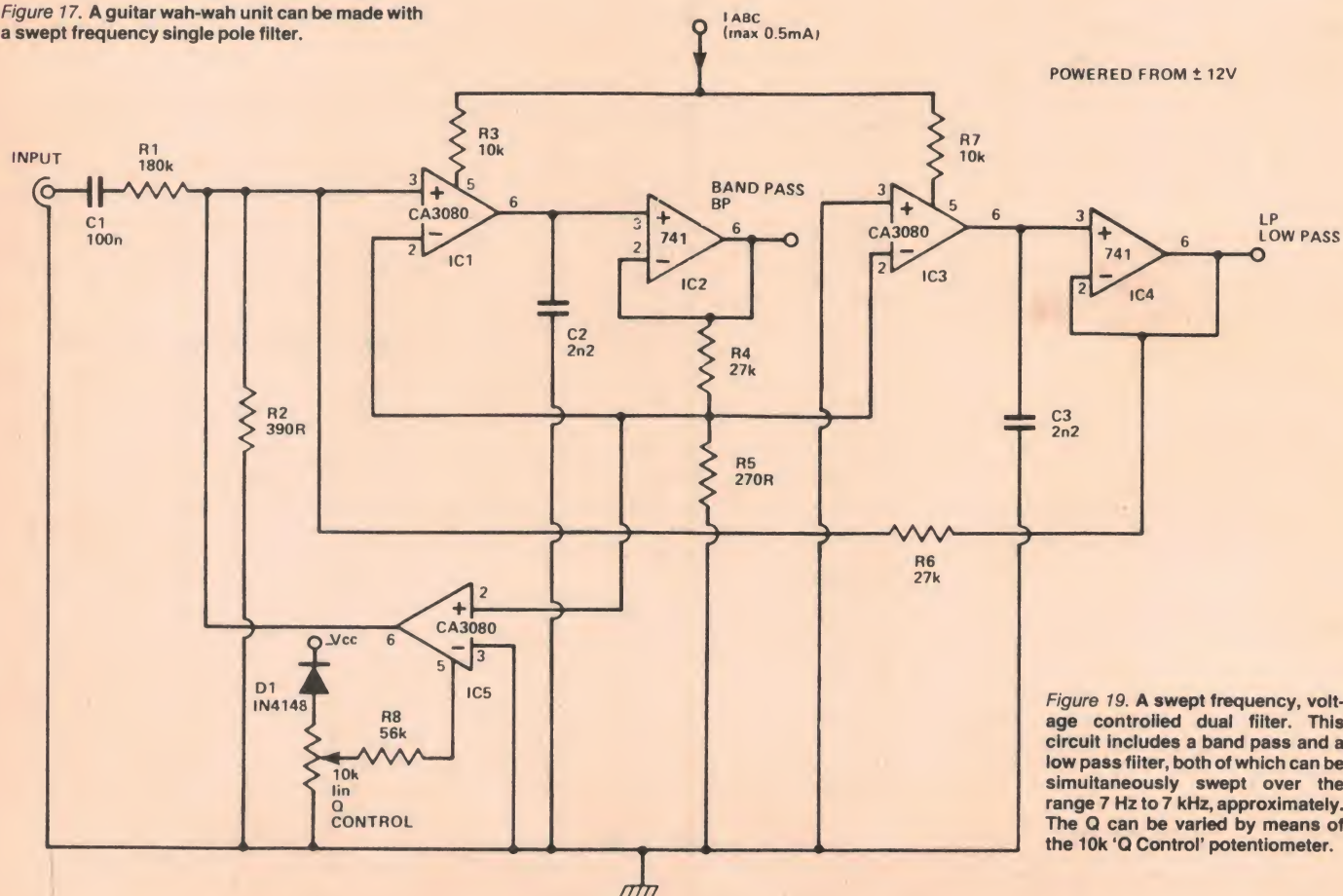


Figure 19. A swept frequency, voltage controlled dual filter. This circuit includes a band pass and a low pass filter, both of which can be simultaneously swept over the range 7 Hz to 7 kHz, approximately. The Q can be varied by means of the 10k 'Q Control' potentiometer.

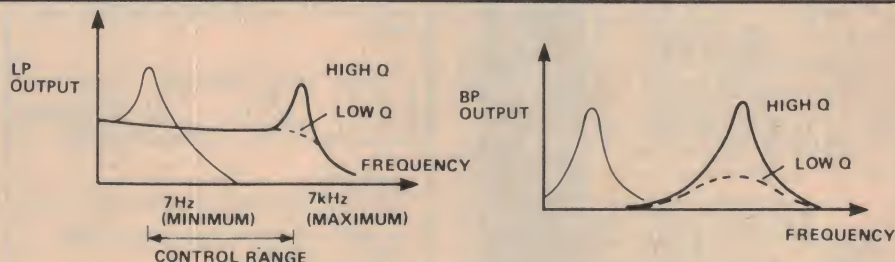
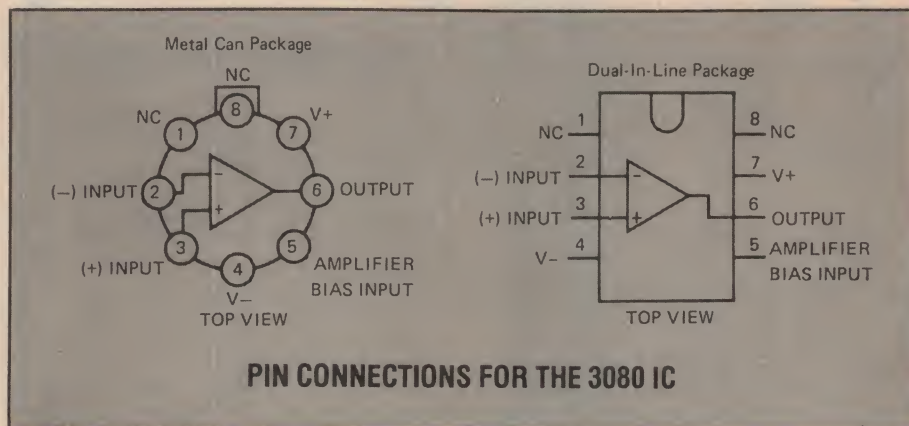


## Voltage controlled filter

A standard dual integrator filter can be constructed using a few CA3080s. By varying  $I_{ABC}$ , the resonant frequency can be swept over a 1000 to 1 range. IC1 and IC3 are two current-controlled integrators. IC2 and IC4 are voltage followers which serve to buffer the high impedance outputs of the integrators. A third CA3080 (C5) is used to control the Q factor of the filter. Q factors as high as 50 can be obtained. The resonant frequency of the filter is linearly proportional to  $I_{ABC}$  and hence this unit is very useful in electronic music production.

There are two outputs, a low pass and a band pass response. Minimum frequency is around 7 Hz to 10 Hz, upper frequency is around 7 kHz or so. Changing C2 and C3 will alter the upper and lower frequency limits. ●

Figure 20. Illustrating the operation of the filters in the Figure 19 circuit.



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- \* Full range of quality Multitesters, Panel Meters, Indicators.
- \* Special meters to customer specifications.



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STANDARD COMPONENTS Pty Ltd.  
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**MARTIN de LAUNAY Pty. Ltd.**  
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270 Keira St, Wollongong, 28 6020

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ELECTRONIC COMPONENTS Pty. Ltd.  
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RADIO PARTS GROUP  
562 Spencer St, West Melbourne, 329 7888  
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**S.A.**  
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SYSTEMS Pty. Ltd.  
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45 Kirwan St, Floreat Park, 387 4966

**QLD**  
AUDIOTRONICS  
396 Montague Rd,  
Westend, Brisbane, 44 7566



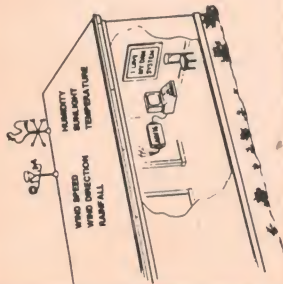
## NEW-FEELINGS

Now your computer can sense the Real World with sixteen 8 bit Analog inputs with our DAM (Data Acquisition Module). Measure Temperature, Light, Pressure, Distance, Db, etc., etc. — It's an experimenter's delight while being a useful tool for Computer Control and Measurement.

**COMPLETE SET FOR PET** (including power supply and interface modules) \$449.00 including tax.

Sets for other computers and sensors available shortly . . . prices on application.

P.S. We handle the complete Commodore Computer Product range and Trenderm Printers (at competitive prices).



We handle a wide range of speaker components including RCF, Plessey-Foster and Motorola. Two of the Motorola Piezo-Ceramic tweeters are the KSN1001, which will handle 100W, with a response from 4K to 30 KHz, and KSN1025 which will handle 150W with a 2K to 30KHz response. These tweeters feature excellent transient response, low distortion, high impedance, high reliability and light weight. The KSN1001 is only \$13.00 and the KSN1025 is only \$25.00 (no cross-over is required).

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EARTH LEAKAGE PROTECTED POWER OUTLETS. These units detect leakage of current out of the circuit (possibly through your body!) and cut off power before a fatality can occur. If you have ever received an electric shock you must realize the worth of these units. From \$116.

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- Ask about our special on the Commodore PET.

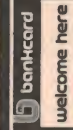


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- Rapid recharge capability fully recharge — 3.5 hours

Available ex stock:

- 5V 500 mA Standard package  
5/500 28 mm x 28 mm x 50 mm
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These standard packages are supplied in insulated packages with fly leads 0.3 metre long. Other package configurations available.



NON  
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LOGIC

### Features

- Data retention for one year in the absence of applied power
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- Standard power supplies only (plus 5V, minus 12V)
- CMOS/TTL compatible
- 14-lead DIL package
- Typically ten million SAVE operations

### DEVICES AVAILABLE

#### MN9102

The MN9102 is a non-volatile 4-bit data latch which uses MNOS\* transistors as memory.

#### MN9105

The MN9105 is a 4-decade BCD counter which counts up or down on negative transitions of the Clock input. In parallel with the counter is a 16-bit non-volatile MNOS memory into which the contents of the counter can be written. When data has been written into the memory it can be retained in the absence of applied power, and subsequently be recalled from the memory to preset the counter.

#### MN9106

The MN9106 is a six-decade up counter in parallel with a twenty-four-bit MNOS memory which can provide non-volatile data storage of the current count position.

#### MN9107, MN9108

The MN9107 will count up to 99 hours, 59 minutes, 59 seconds, while the MN9108 counts up to 9999 hours, 59 minutes or 9999 minutes, 59 seconds.

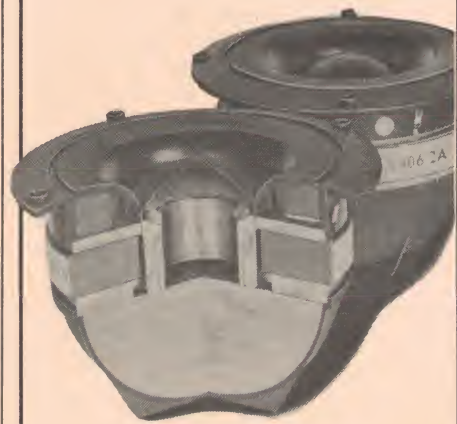
### APPLICATIONS

Applications for NOVOL are found in all forms of metering, security code storage, back-up storage for microprocessor-based systems, elapsed time indicators, electronic counters, latching relays and many other general industrial areas.

### Plessey Agents and Distributors:

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The answer that some eminent manufacturers have to the introduction of directly cut and digitally mastered discs with their 60-70dB dynamic range capability is the fitting of protection devices to so-called state of the art loudspeaker systems.

**DYNAUDIO** components and systems will replay this dynamic range without compression and also the demanding 90dB plus capability of the coming digitally encoded discs. Realistic reproduction has advanced a step forward.

**DYNAUDIO** high fidelity drivers use hexagonal wire, ferrofluidics and dynamic transient linearity system (DTL) for fast rise time and low IM distortion.

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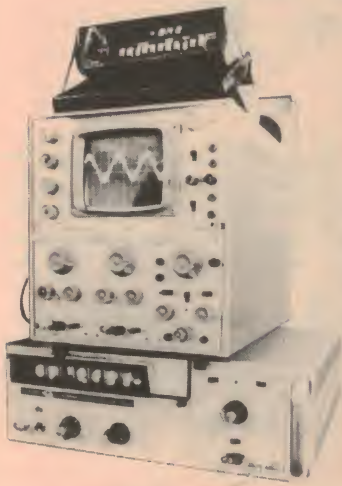
### Available from:

VIC: Soundcraftsmen: 66 Kooyong Rd  
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Tivoli Hi-Fi: 654 Glenferrie Rd  
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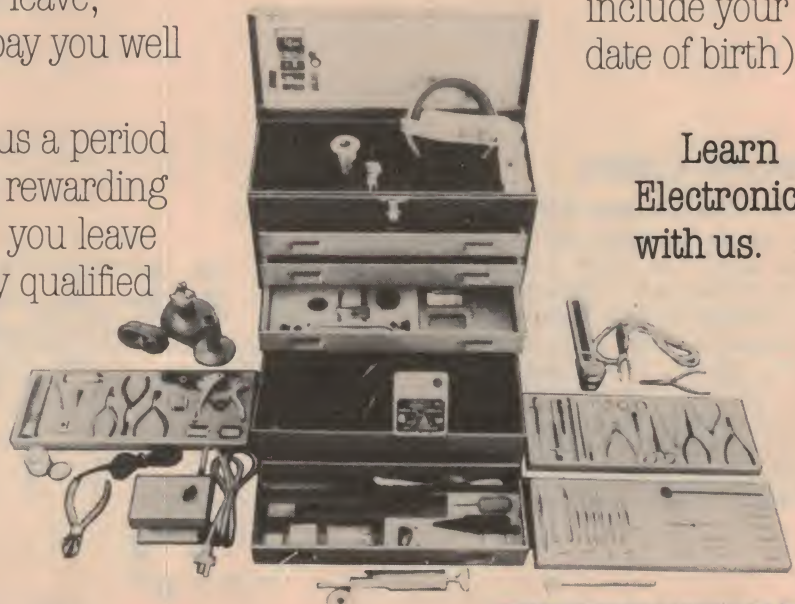
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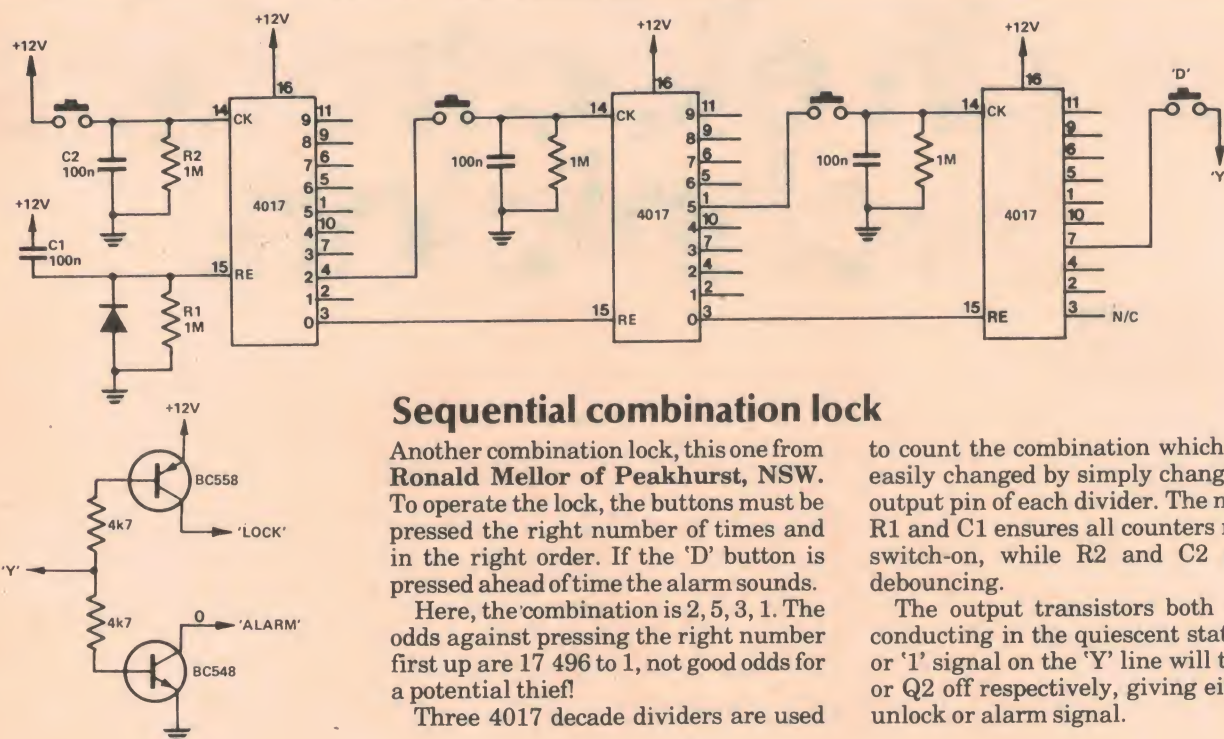


Authorised by Director-General of Recruiting, Dept. Defence.  
TSAP15.FP.48



# Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



## Sequential combination lock

Another combination lock, this one from **Ronald Mellor of Peakhurst, NSW.** To operate the lock, the buttons must be pressed the right number of times and in the right order. If the 'D' button is pressed ahead of time the alarm sounds.

Here, the combination is 2, 5, 3, 1. The odds against pressing the right number first up are 17 496 to 1, not good odds for a potential thief!

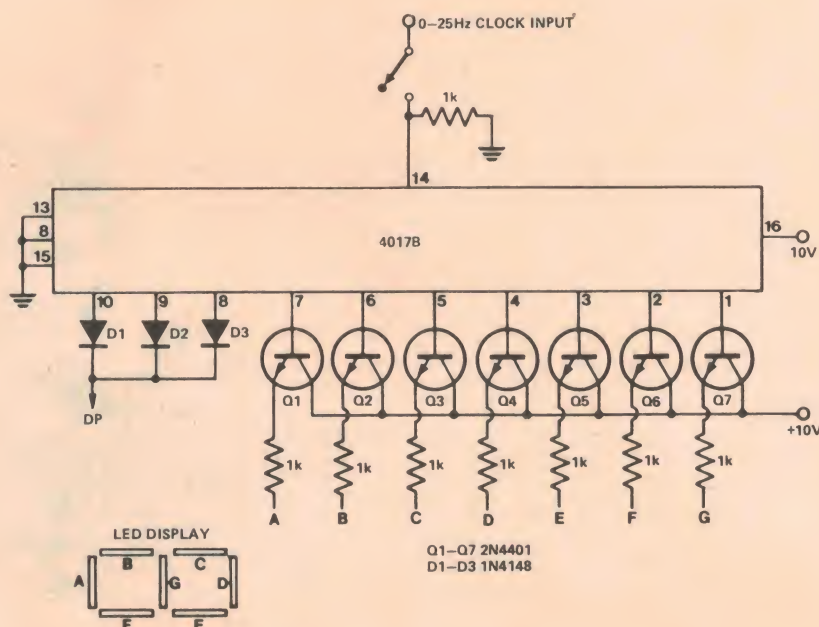
Three 4017 decade dividers are used

to count the combination which can be easily changed by simply changing the output pin of each divider. The network R1 and C1 ensures all counters reset at switch-on, while R2 and C2 are for debouncing.

The output transistors both remain conducting in the quiescent state. A '0' or '1' signal on the 'Y' line will turn Q1 or Q2 off respectively, giving either an unlock or alarm signal.

## Electronic casino

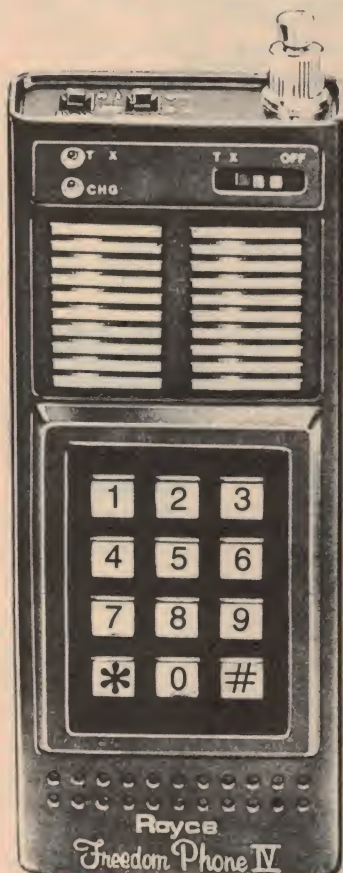
This is a game of chance which can be played by up to seven players. The decimal point has three connections which gives the house a three out of ten chance of taking all bets. The clock is set at a frequency which gives a rapidly flickering display. When a player holds down a key for a few seconds and releases it the display stops and a number or point is displayed. The odds are on the point. Submitted by **Keith Bennet and Peter White of Burwood, Victoria.**





# Royce Freedom Phone IV

PORTABLE PHONE SYSTEM



THE HANDSET MODEL T-026

**COMPLETELY PORTABLE  
CORDLESS PHONE SYSTEM**

- Fully portable wireless telephone.
- Pocket sized — belt clip supplied.
- Rechargeable batteries included.
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This instrument is not a Telecom-approved apparatus and as such cannot legally be connected to Telecom equipment.

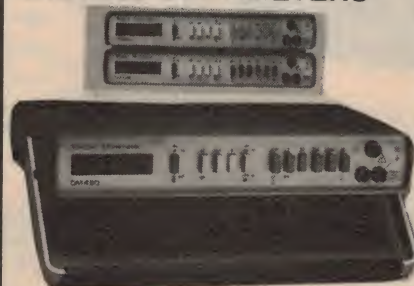
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## sinclair

DM350 3½ DIGIT &  
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PROFESSIONAL QUALITY  
DIGITAL MULTIMETERS



DM350	DM450
NORMALLY \$210.56	NORMALLY \$271.29
<b>SPECIAL PRICE</b>	<b>SPECIAL PRICE</b>
<b>\$159.85</b>	<b>\$199.00</b>

The DM350 and DM450 represent a breakthrough in digital multimeter development. The two instruments are identical in format but have full scale display lengths of 3½ digits and 4½ digits respectively. They have been designed to a laboratory quality specification, whilst retaining the robustness, low weight and internal power source which enable them to be truly portable.

### Very high accuracy and stability.

Basic calibrational accuracies are 0.05 percent for the DM450 and 0.1 percent for the DM350. Both instruments use a very high stability A to D conversion technique with a minimum of preset adjustments, enabling a 12 month calibrational stability figure to be guaranteed.

### Fully protected

#### Six functions in 34 ranges

Both multimeters provide a total of 34 ranges covering features unavailable on many high cost laboratory multimeters. In addition to standard 10M ohm input impedance the basic DC range can be selected with an impedance greater than 1000M ohm — invaluable for work with micro power and MOS circuitry. Ultra wide current handling provides 1 nA resolution for such things as low current transistor  $\beta$  measurements or capacitor leakages, and measurement up to 10A (20A intermittent) for work with high power circuits. A diode test facility gives direct reading of forward voltage drop. AC frequency response up to 20KHz copes with audio testing and design.

— DC voltage 10uV to 1200V (100uV on DM350)

~ AC voltage 100uV to 750V

— DC current 1 nA to 10A

~ AC current 1 nA to 10A

Resistance 10M ohm to 20M ohm (100 ohm on DM350)

Diode Test Forward voltage drop at 1 mA

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\$85.00 plus \$2.00 P&P

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...hurry, stocks are limited.  
5 foot halical aerials with adjustable SWRing ferrule ..... \$18.50  
Standard aerial base ..... \$4.50  
12 foot lead with PL259 plug ..... \$3.75



## PHILIPS FM320 UHF TWO-WAY RADIO (CB)

If you want a professional business-like two-way radio in your car without spending thousands of dollars on commercial equipment, then this transceiver is for you.

Beautifully designed in Australia and completely legal to use by anyone (providing you obtain your PMG licence which is yours for only \$25). The unit runs from 12 volts, negative earth, and can be installed in a matter of minutes as it just slips under the dash.

You have 40 channels of static free listening and the number of uses that you can put your UHF is unimaginable - emergency, meeting new friends, business, telling the wife you're going to be late home, car rallies, etc.

...all this for ONLY \$289 (Compare our price with others).  
Mobile UHF Aerial ..... \$19.99  
Gutter mounts ..... \$9.50  
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## TV.CRD ADAPTOR KIT

(E.A. May '80) fantastically popular - turn your old TV into a CRD. .... ONLY \$29.40 (without power adaptor)

Two power adaptors available:  
(i) 240V to 6.75/9V d.c. .... \$9.50  
(ii) 240V to 9V d.c. .... \$5.95

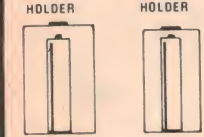


## DIGITAL CAPACITANCE METER KIT

Here is an inexpensive digital capacitance meter, which measures from 1pF to 99.99 uF in just three ranges. It's simple to use and features a big bright four-digit display with automatic updating and decimal points. Display digits 13mm high. Case dimensions 184(d) x 70(h) x 160(w) mm. .... ONLY \$59.90 (Kit is complete right down to last nut and bolt)



## D' BATTERY HOLDER C' BATTERY HOLDER



Some of your equipment will take penlite batteries, some 'C' cells, some 'D' cells, and you are spending a fortune on batteries. Well now your problems have been solved and you only need to buy penlite batteries, as these two conversion units convert them to 'D' or 'C' and are only 59 cents ea.

## CORAL SPEAKER SYSTEMS

Fantastic sounding speakers at a price you can afford. With prices using every day it is refreshing to see a quality product that is budget priced, but with a famous brand name and outstanding performance.

**CORAL 12" (300mm) 4 SPEAKER, 3 WAY SYSTEM (60 WATTS, 8ohm)**

**SPEAKER KIT (300mm) 12" (CORAL)**  
The speaker kit consists of two 12" 300mm woofers, two 5" (125mm) midrange, and four 2" (62.5mm) tweeters with two 3-way crossover networks and all screws, terminals, and internal wiring.

**SPECIFICATIONS:** Infinite baffle speaker enclosure, frequency response 30Hz to 20kHz, 8 ohms impedance, 95dB sensitivity, 60 watts, crossover at 1kHz and 10kHz.

..... ONLY \$129.00 pair (IN B. Playmaster 3 way 12" Speaker Kit \$164.00 pair Philips 3 way 80 watt Speaker Kit \$220.00 pr.)

## BOX KIT (300mm) 12" (CORAL)

Beautiful wooden box kit supplied in easy to put together flat pack - just fold together and glue. Walnut vinyl, includes innerboard and speaker cloth. Front baffle completely cut out and speakers just screw into it.

Dimensions 65cm(h) x 38cm(w) x 29cm(d). .... ONLY \$89.00 pair compared with similar boxes, this price is unbelievable

## COMPLETE CORAL 12" (300mm) 4 SPEAKER 3 WAY (including woodwork)

..... ONLY \$218.00!!!!  
Philips 12" 300mm 3 way 80W kit \$320.00  
Playmaster 12" 300mm 3 way kit \$298.00  
Mail Order \$100 packing "freight on" \$29.00

## 3 SPEAKER KIT

150 watts, 8 ohm. Consists of two 10" (250mm) woofers, two 5" (125mm) midrange and two 2" (62.5mm) tweeters, with two 3-way crossover networks and all screws, terminals and internal wiring.

Box size requirements 56cm(h) x 33cm(w) x 27cm(d). .... ONLY \$95.00 pair

## CORAL 200mm (8") 3 WAY 3 SPEAKER KIT

150 watts, 8 ohm. Consists of two 8" (200mm) woofers, two 4" (100mm) midrange and two 2" (62.5mm) tweeters with two 3-way crossover networks and all screws, terminals and internal wiring.

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**THE FAMOUS T159 PROGRAMMABLE CALCULATOR** - Years ahead of its time - similar to a computer in that you can write your own programmes, etc. .... \$299.00

## PHILIPS SPEAKERS

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(A08066/W8 or A080562/W8) woofer, 40W RMS, 8ohm, freq. response 30Hz to 7kHz ..... \$29.50

250mm(10") (A010100/W8) Woofer, 40W RMS, 8ohm, freq. response 40Hz to 5kHz ..... \$57.50

300mm(12") (A012100/W8) Woofer, 40W RMS, 8ohm, freq. response 30Hz to 1.2kHz ..... \$57.50

300mm(12") (A012250/W8) Woofer, 100W RMS, 8ohm, frequency response 40Hz to 2kHz ..... \$86.95

### CROSSOVER NETWORKS

**ET14000/1 4 WAY CROSSOVER NETWORK (Kit form)**

Crossover points: 150Hz, 750Hz, 3kHz, 100W RMS (designed by ETI) 8ohm. Size 330mm x 246mm ..... \$170 pair

**ET14000/2 3 WAY CROSSOVER NETWORK (Kit form)**

Crossover points: 700Hz and 3kHz, 100W RMS (designed by ETI) 8ohm. Size 210mm x 130mm ..... \$91 pair

**ADF500/4500/8 3 WAY CROSSOVER NETWORK (Completely assembled)**

Crossover points 500Hz and 4500Hz, 40W RMS (Philips design), 8ohm. Size 105mm x 100mm ..... \$41 pair

## MIDRANGE SPEAKERS

157mm(7") (A070601/W8) Low Midrange or Woofer, 30W RMS, 8ohm, frequency response 400Hz to 3kHz ..... \$22.95

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50mm(2") (A00210/S8) Midrange, 50W RMS with recommended crossover, 8ohm, frequency response 500Hz to 5kHz ..... \$34.75

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25mm(1") (A00162/T8) Tweeter, 40W RMS with correct crossover, 8ohm, frequency response 1600Hz to 20kHz ..... \$13.95

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ridge input. Can be driven from magnetic cartridge with simple addition of special preamp kit. \$8.50 - preamp can be powered direct from rail voltage of amp (diagram provided).

Transformer (specially wound for this amp) only \$9.50

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Specially designed high power transformer. 240V a.c. primary. Secondary 2 x 47V @ 3A, 2 x 15V @ 1/8A (96 x 114 x 110mm) ..... \$32.50

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CASES suitable for 300 Watt Amp or wherever a large case is required:

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Beautifully designed (supplied in flat pack), satin anodised 1.6mm aluminium front and back panels, with surfaces suitable for screen printing etc. Top and bottom panels of hard wearing black "marvplate" with 1.0mm steel base. Side panels 3.0mm satin anodised aluminium with chrome handles.

Four aluminium extrusions are used to hold the top, bottom, front and back panels in position. Size 134mm(h) x 419mm(w) x 280mm(d) ..... \$55.00

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Exactly the same size and same materials as used in ET14000 rack mount case, except side panels are made of teak wood (13mm) for a really superb looking case. .... ONLY \$45.00

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We not only have the software, we have the hardware as well.

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(as illustrated) ..... \$999.00

CBM3016 16K COMPUTER (includes VDU) ..... \$1859.00

CBM3032 32K COMPUTER (includes VDU) ..... \$2,249.00

CBM3040 341K ..... \$2,329.00

CBM3022 PRINTER (80 column dot matrix) ..... \$1,799.00

16K SORCERER COMPUTER (less VDU) ..... \$1,395.00

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With all units a cassette recorder is included in price.

### PROGRAMS FOR CBM SYSTEM

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General Ledger ..... \$1,500.00

NEW "ELECTRONICS AUSTRALIA" LIGHT CHASER KIT

(See EA August '80) ..... ONLY \$65.00

Exactly the same case as used in the famous "Electronics Australia" Muscular Fut details in this issue.

Our kits feature a fully pre-drilled case and front panel with high quality knurled aluminium knobs and full instructions to make this very simple to construct kit.

Absolutely everything supplied in kit - you need is some simple basic tools like screwdriver, soldering iron, etc.

100WATT SPOT FLOODS 8.C. (Red, green, yellow, blue) ..... \$6.50 ea

25 WATT COLOURED B.C. GLOBES (Red, orange, yellow, blue) to suit EA Light Chaser ..... \$1.50 ea

25 and more ..... \$1.38 ea

NE2 NEEDS 90V a.c. ..... 40v ea (for light chaser)

25 or more ..... 30v ea

N.B. a 220K Resistor has to be inserted in series with NE2 for 240V a.c. 4d ea

Standard 8.C. base for lamps ..... \$1.40 ea

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A really versatile unit with bass, presence, treble and master volume controls. It also has its own power supply on board and can be powered directly from 15-0-15 Volts on power transformer - all components and PC board ..... \$29.50

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and that is exactly what we have done with the new

## ELECTRONICS AUSTRALIA 300WATT PLAYMASTER AMPLIFIER

We have dressed it up and put it into a beautiful case and ask us why it is not selling for \$600 like similar commercial amps

but no, from just \$220.00 (with wooden sided 4000 case this magnificent 300WATT POWER AMPLIFIER can be sitting in your lounge room and you'll also be able to say "I built it!"

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### COMPLETE KIT including 300W module, power supply, speaker protector, chassis pack, fan & wooden sided case: \$220.00 (with wooden sided case [4000]) \$230

(with ET14000 metal rack mounting case)

### PLAYMASTER 300WATT AMPLIFIER module kit (EA July '80).

The full technical know-how of the "Electronics Australia" staff has been put into designing this superb project

The 300 Watt Amplifier Module Kit includes heatsink, thermal cut out, nuts, bolts, silicon grease, mica, solder - all you need is a soldering iron, screwdriver, a pair of cutters, drill and Stanley knife and it's a good idea to have a trusty multimeter (we have them from \$9.50)

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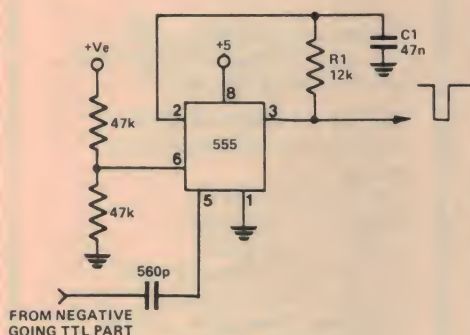
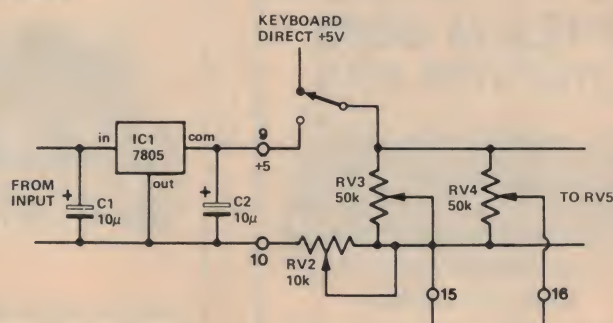


# Ideas for Experimenters

## Keyboard tracking for the ETI sequencer

Val Starr of Canberra, ACT, has made a small modification to our sequencer to allow it to track up or down in key with the keyboard, giving a very noticeable effect on short runs of four notes or so. This effect is used extensively on modern pop recordings.

The +5V line is broken between IC1 and RV3 and fed to a switch. The +5V supply can then be taken from the regulator as before, or from the keyboard for tracking.

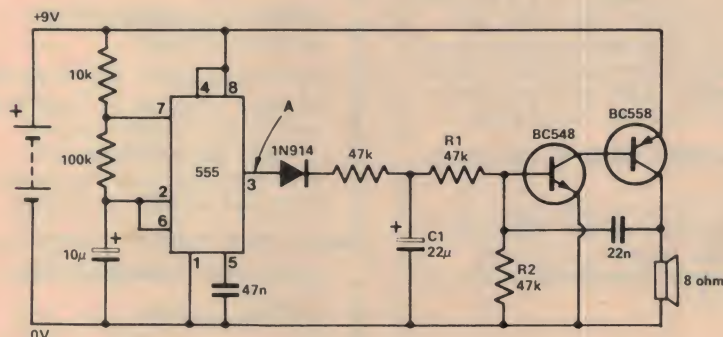


## The 555 upside down !

Normally, a 555 is used with negative triggering for a positive output pulse but it doesn't have to be this way, as pointed out by **J.L. Elkhorne of Chigwell, Tasmania**. An inverted scheme can also be used, giving positive triggering and a negative-going output.

The trick is to use the upper comparator in a different way by biasing the threshold port, pin 6, at half supply and using the control voltage port, pin 5, as the trigger input.

The pulse length is determined by the time constant of R1 and C1, the larger either value, the longer the pulse.



## Siren circuit

This circuit simulates the sound of an American police car. Just the thing to stimulate a child's ebbing enthusiasm for an expensive Christmas present!

The 555 timer is used as a very low frequency oscillator giving regular charges to the 22µ capacitor, C1. The capacitor discharges through R1 and R2 until the next pulse comes from the 555.

The changing voltage on the base of the first transistor changes the frequency of the oscillator, rising quickly in frequency and falling slowly.

Flashing LEDs can be added with a current limiting resistor at the point marked 'A'. Submitted by **David Brighton of Huonville, Tasmania**.

## Any ideas?

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between \$5 and \$10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.



## DREAM USERS CLUB

Monthly newsletter featuring programmes, hardware and tips. The first issue is September and costs \$4.00. A free issue is sent to those who submit programmes that are accepted for publication. Interstate members welcome. Send cheque or money order to:

NSW 6800 Users Group, 27 Georgina Ave, Keltraville, NSW, 2500.

## DREAM 6802 COMPUTER KITS



### SPECIAL OFFER

All orders received this month will receive a Software Manual at no extra charge. The prices shown have not changed since 1979, are limited to current stock, so be quick. Send the coupon or place a phone C.O.D. order.

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- ☐ R.F. modulator.....\$3.00 ea.
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.0022 - 5c	.022 - 6c	.22 - 15c
.0027 - 5c	.027 - 6c	.27 - 16c
.0033 - 5c	.033 - 7c	.33 - 18c
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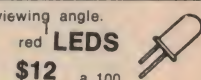
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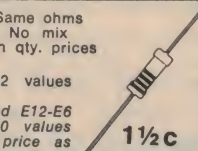


**red LEDs**  
**\$12 a 100**  
**15c each** Best value  
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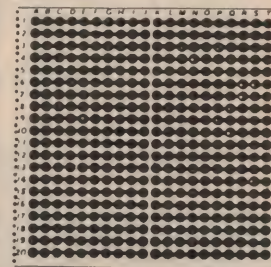
(per 100 prices in brackets) Cap.	16V	25V	50V
0.47uF	4c(\$3 1/2)	5c(\$3 1/4)	6c(\$4)
1, 2.2, 3.3, 4.7, 10uF	5c(\$3 1/2)	6c(\$3 1/4)	7c(\$4)
22uF	6c(\$3 1/4)	7c(\$4)	
33uF	8c(\$4)		
47uF	9c(\$5)	10c(\$6)	11c(\$7)
100uF	10c(\$6)	12c(\$7)	14c(\$11)
220uF	12c(\$8)	16c(\$10)	35c(\$17)
470uF	16c(\$12)	22c(\$16)	45c(\$30)
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# Shoparound

## The 3080 IC

This useful little chip, featured in Lab Notes this month, is made by RCA and National Semiconductors. You'll find it labelled CA3080 (from RCA) and LM3080 (from NS). It is available in both metal can and DIL packages. Either make or package is suitable for

the circuits suggested in Lab Notes. To the best of our knowledge, at time of going to press, the following firms sell the 3080: In Melbourne — Ellistronics and Radio Parts in the city, Rod Irving in Northcote, Semis Unlimited (mail order only) and Tasman Electronics in Coburg. In Sydney — Radio Despatch



This heatsink, made locally by Rod Irving Electronics, is available in a variety of lengths, both anodised and unanodised. It measures 105 mm wide overall and the centre section is 35 mm wide by 5 mm thick. There are five fins on each side and a 220 mm length (anodised) has a thermal rating around 1°C/watt in free air. See Rod Irving Electronics, 425 High Street, Northcote Vic. 3070. (03)489-8131.

Service in the city and Electronic (distributors) in Pendle Hill.

No trouble should be experienced finding parts for the Scratch and Rumble Filter or the LED Voltmeter.

## AM Tuner

The tuned circuits in the AM tuner are designed to give a constant bandwidth across the tuning range, the correct 'Q' for the desired bandwidth and good rejection of adjacent stations. The pot cores cannot be substituted with ones of a different size, material, or 'ue' value. Philips have agreed to make stocks available ahead of time so supplies should be obtainable by the time this issue goes on sale.

The dual tuning gang and vernier drive are available from most suppliers (except Dick Smith who doesn't stock the tuning gang or pot cores). Alternatively, both are available from Watkin Wynne, 32 Falcon Street, Crows Nest NSW 2065. Make sure your vernier drive has a flange with tapped holes to mount the dial plate.

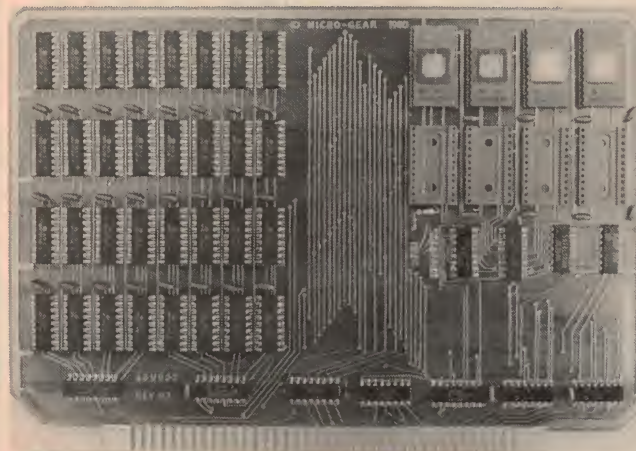
If you don't want to build your own box many suitable ones are available. Try something from the Horwood range, which are common and inexpensive.

## Project price estimates

This information is published as a guide and a variety of factors may affect the actual price of a project, whether obtained as separate components or as a kit.

ETI-475 AM Tuner	\$65 - \$80 (depending on case)
ETI-326 LED Voltmeter	\$10 - \$13
ETI-457 Scratch and Rumble Filter	\$25 - \$30 (stereo version)

## TWO BOARDS IN ONE WITH OUR 68MB02 16K RAM/16K EPROM MEMORY BOARD



- 16K RAM (2114) expandable in 1K increments.
- 16K EPROM (2716, plus 5V) expandable in 2K increments.
- Two 8K RAM blocks selectable in 8K increments.
- Two 8K EPROM blocks selectable in 8K increments.
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**THE TERMINAL YOU DESERVE!**

This memory mapped terminal can be configured to have the intelligence of top serial terminals such as Hazeltine, Lear Siegler, Soroc 'etc' without eye strain and sludgy slow speed.

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**PRICED FROM \$1285.20+ SALES TAX**

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INSTRUMENTAL IN WRITING THE IEEE SPEC FOR S100*

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- S100 CABINETS.
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# LETTERS

Dear Sir,

For some reason best known to themselves, Riddell Exhibitions did not send me an invitation to this year's fifth Consumer Electronic Show (whatever happened to Intellect '80?) in Sydney, so I didn't know when the trade sessions were scheduled. Curiously, July ETI's lavish guide to the CES was crammed with information about everything except when the damned thing was on. By the time I got around to calling Riddells in Melbourne, the trade sessions were over so I had to front up with the great unwashed, pay my \$2, and honestly, it really wasn't worth it.

In fact, I fail to see the point of having the show at all. Indeed, if the average exhibitor cannot rustle up a little more energy, enthusiasm and imagination than was evident this year I wonder why they bother. (ETI naturally excepted!). Flair would be going too far!

My impression is that important exhibitors *are* staying away (maybe in favour of the specialised hi-fi and computer shows?). No doubt the organisers will say space bookings were a record, but they have gone way down-market with Sanyo predictably dominant and half-a-dozen side shows selling funny telephones and computerised handwriting analyses and biorhythm charts. For heaven's sake!

My impression *may* be distorted by the boredom which quickly set in after half-an-hour of seeing nothing that's not on display in any large regional shopping centre.

It happens that this year, apart from my professional interest, I am in the market for a hi-fi system. Where were Technics? Where were Sharp? RetraVision had a Sharp display with four women demonstrating microwave ovens and one beleaguered male managing everything else. No, he didn't have any literature on calculators (heavy Sharp sales campaign currently), the kids pinch it all. Optonica? Forget it! In fact, there was virtually no literature available anywhere. No one manning the JBL stand. Bose were solely into car stereo. The supposedly informative descriptions on the Marantz display bore no relation to the systems displayed beside them!

I did unglaze my eyes momentarily to glance at Pioneer's laser video disc display. Although the monitor picture quality was only slightly worse than the receiver in an average country motel, it

was nonetheless highly educational, being the first time I've ever seen what looked like multipath transmission from closed circuit TV!

John J. Howard  
Aust. Film & Television School

Well, John . . . if you pick up your (I expect) dog-eared copy of the July ETI, turn to page 67 and read the first paragraph of the "lavish guide", you will find the dates of the (now passed) Consumer Electronics Show. Unfortunately, at time of going to press, we could not inform readers of trade times or general exhibition hours — we didn't know them! Newspaper and radio advertising prior to, and during, the C.E. Show gave the information. Still, our omission didn't help.

As for the great unwashed . . . they didn't come onto the ETI stand!

Getting back to the point, viz: having the show, it seems the *raison d'être* is:-

- (a) To launch new products
- (b) Generate sales prospects and
- (c) hopefully, stimulate sales

The Show also serves to put companies' names 'on the map'.

The fifth C.E. Show (incorporating Interlect '80 — which was to be the show's 'new' name) was broadened to include any product which "plugged into a three-pin outlet or ran off batteries". Hence the proliferation of 'white goods' and other domestic products. For someone 'in the business', your view is probably close to being saturated. For the "great unwashed", exposure is probably considerably less. Certainly, attendance was massively up on last year. This year's Saturday/Sunday attendance exceeded last year's total attendance by a wide margin.

From the sound of it, you missed a personal guided tour of the Marantz stand by the Penthouse Pet. She was probably on the Bose stand while you were at Marantz's, and on the Marantz stand . . . etc. Bose had a speaker demonstration room and ran audio-visual sessions. Perhaps you thought it was their back room? You seem to have missed Philips' and JVC's video disc demos, too.

Ah, well. Next year you can pack a picnic lunch and yodel out to Yennora . . .

Full report on the fifth C.E. Show from master show reporter and journalist extraordinaire, Dennis Lingane, next issue.

Roger Harrison Editor

## JBL's 4311 STUDIO MONITOR.

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1. 4K RAM Memory Expansion Chips, 2114 450nS, \$52.
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3. Superboard 11 Cover/VDU Stand, \$18.95.
4. Superboard 11 Computer, 8K ROM, 4K RAM, \$389.
5. Challenger C1P Computer, 8K ROM, 4K RAM, \$489.
6. Challenger C4P Computer, Sound/Colour, \$946.20.

### SOFTWARE

We regret PRICE RISE due to shipping costs. All previous (54) advertised Cassette Software up \$2.00. Instructions (14 sets) are still the same price. 01 is now replaced by an updated and enlarged C1 at \$2.95.

### New Programs for Ohio Software

#### UTILITIES

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- U.17. Trace.....\$12.95
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- U.19. Cursor — C2/4.....\$13.95

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- I.13. Wp 6502 Word Processor Book.....\$3.95
- I.14. Disassembled ROM, with Inbuilt References \$13.95
- I.15. Sound — S il/C1P.....\$6.95
- I.16. G.T. Conversion, X2.....\$2.95
- I.17. Saving Data on Tape.....\$6.95
- I.18. C1P Tape Control.....\$6.95
- I.19. C1P Beeper.....\$5.95
- I.20. C1P Base 2 Printer.....\$6.95
- I.21. Morse Code Converter with tape.....\$16.95
- I22 supplement to I12 32x64 character display.
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- B.4. Savings & Loan Package.....\$14.95

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# Australia's first under \$300 COMPUTER...

**\$295**  
INCL. ZX80 BASIC  
MANUAL

Remember — all prices shown include sales tax, postage and packing.

N.B. Your Sinclair ZX80 may qualify as a business expense.

## Sinclair ZX80 - British made.

Until now, building your own computer could cost you around \$600 — and still leave you with only a bare board for your trouble. The Sinclair ZX80 changes all that. For just \$295 you get **everything** you need including leads for direct connection to your own cassette recorder and television. The ZX80 really is a complete, powerful full-facility computer matching or surpassing other personal computers costing much more. The ZX80 is programmed in BASIC and you could use it for anything from chess to running a power station.

Two unique and valuable components of the Sinclair ZX80: the Sinclair BASIC interpreter and the Sinclair teach-yourself BASIC manual. The unique Sinclair BASIC interpreter: offers remarkable programming advantages — unique 'one touch' key word entry. The ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST etc) have their own

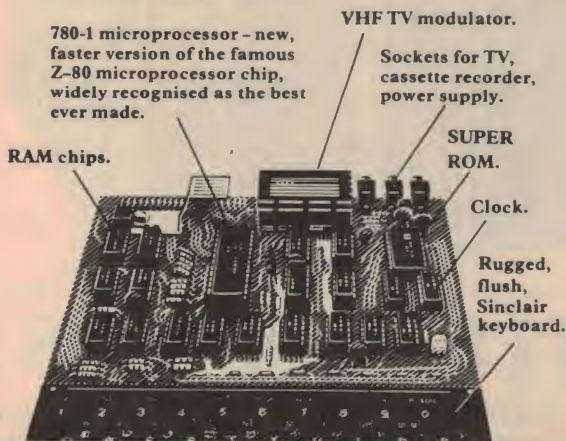
single key entry. Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately, preventing entry of long and complicated programs with faults only to discover them when you run.

Excellent string handling capability — takes up to 26 string variables of any length. All strings can undergo all rational tests (e.g. comparison). The ZX80 also has string input to request a line of text; strings do **not** need to be dimensioned. Up to 26 single dimension arrays. FOR/NEXT loops nested up to 26. **Variable names** of any length. BASIC language also handles full Boolean arithmetic, conditional expressions, etc.

Exceptionally powerful edit facilities, allows modification of existing program lines. **Randomise function**, useful for games and secret codes. **Timer under program control**. PEEK and

POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine. **High resolution graphics** with 22 standard graphic symbols. The Sinclair teach-yourself-BASIC manual 96 page book free with every kit.

Fewer chips, compact design, volume production means **MORE POWER FOR YOUR DOLLAR!** The ZX80 owes its low price to its remarkable design; the whole system is packed onto fewer, newer more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer because the ZX80's brilliant design packs the RAM so much more tightly. (Key words occupy just a single byte). You can add to the memory via the expansion port, giving a maximum potential of 16K.



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	Ready-assembled Sinclair ZX80 Personal Computer(s). Price incl. ZX80 BASIC manual excl. mains adaptor.	\$295.00	
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	Memory Expansion Board(s) takes up to 3K bytes.	\$ 28.50	
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	Sinclair ZX80 Manual(s) free with every ZX80 computer.	\$ 15.00	
		<b>TOTAL</b>	

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### APPLICATION SOFTWARE (CUSTOMISED, INSTALLED AND FULLY SUPPORTED)

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Purchase journal, cheque writing, accounts payable ageing and cash forecast. General ledger reports including: G/L budget trial balance, working trial balance, chart of accounts. Financial reports including: balance sheet, income statements, budget reports, and budget schedules.

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Automatic pay processing, instant employee information, full tax calculation, full deduction reporting, optional cheque production, labour distribution reports and group certificates.

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Order entry and invoicing, stock control, back ordering, sales analysis, cash receipts, age trial balance, debtors ledger and statements.

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Screen based system, document oriented word processor, full access to data processing files, powerful merge and print queuing facilities which operate in "background mode", leaving the operator free for editing and revision. Printer options to handle plastic or metal daisy wheel, letterheads, continuous stationery, automatic sheet feeding and custom stationery.

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- **APF HOME COMPUTERS.**
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For calculator prices see July ETI.

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Insurance brokers system, law firm accounting/word processing, accountant's client accounting, medical group accounting, real estate/property management, motor dealers system — including finance and insurance applications, contractors/builders job costing, manufacturer's bill of material and requirements planning, pharmaceutical system, production planning/manufacturing job costing, textile/clothing industry system, newspaper management and transport management system.

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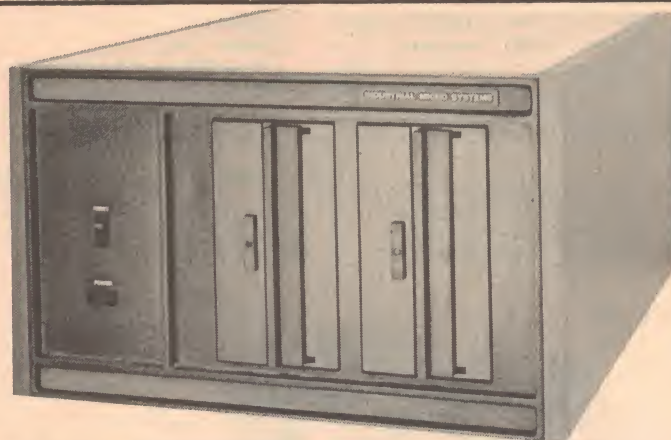
## Micro Computers From INDUSTRIAL MICRO SYSTEMS SERIES 8000: SYSTEMS WITH TIME PROVEN COMPONENTS

## SERIES 8000

Regardless of the size of machine you choose, there's room inside for up to 256k of IMS RAM with memory management. And the integrated floppy disk capacity is pretty impressive too — more than a million bytes per drive! You can start with a single 8" drive, then install one or two more when you need it — all in the same cabinet. The Series 8000 System's power supply and disk controller are made with this kind of expansion in mind so growing is simple. And our Z-80 computers have features like serial parallel I/O's, clocks, PROMS on board so that less slots are used on the S-100 12 slot motherboard, giving more space for extra RAM or special purpose boards.

Because the system is S-100 and CP/M based you can run all of the programs written for use with CP/M systems. (Like CBASIC, FORTRAN, COBOL, PASCAL, C, ALGOL, WORDSTAR etc). And you can go multi-user as well!

CALL US FOR MORE INFORMATION ABOUT THIS SYSTEM OR IT'S LITTLE BROTHER WITH THE 5" DISKS — THE SERIES 5000.



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### 16K EPROM CARD-S 100 BUSS



**\$89.50  
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**FIRST TIME OFFERED!  
BLANK PC BOARD - \$39**

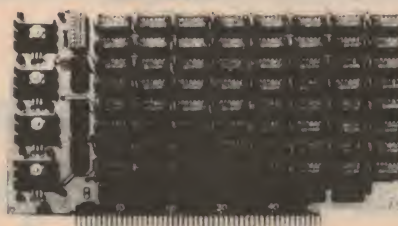
**USES 2708's!**

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

**OUR 450 NS 2708'S  
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Blank PC Board w/Documentation

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Low Profile Socket Set 13.50

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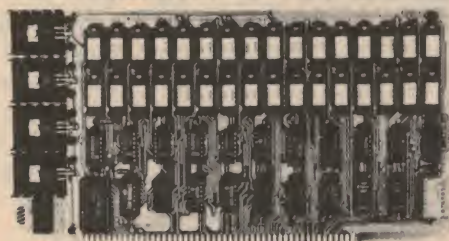
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### 16K STATIC RAM KIT-S 100 BUSS

**KIT \$249  
A&T \$279**



#### KIT FEATURES:

1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

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**ASSEMBLED & TESTED-ADD \$30**

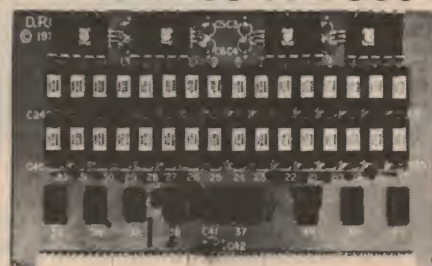
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**\$279**

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**FOR SWTPC  
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#### KIT FEATURES

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board Solder mask and silk screened layout. Gold fingers
5. All Parts and Sockets included
6. Low Power! Under 1.5 Amps Typical

**BLANK PC BOARD— \$39 COMPLETE SOCKET SET— \$19  
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### ITHO Model 8300 PRINTER. \$770 plus 15% sales tax.

This 80-column printer provides quiet operation, making it suitable for use in offices, classrooms and homes. Specifications include 125 cps, 60 lines per minute, paper loading from bottom or rear and Centronics-compatible, parallel interface.

A bidirectional, dot matrix impact printer with a print head designed for 100 percent duty operation, assuring a print life that exceeds 100 million characters. The precision sprocket-feed mechanism permits printing forms from 4 1/2 to 9 1/2 inches wide. A 96 ASCII character set prints in upper and lowercase with the added capability of producing double-width fonts in boldface. The vertical format unit provides preprogrammed/ programmable tab positions, top of form and bottom of form for complete formatting capabilities.

**RITRON 8 SLOT MOTHERBOARD: KIT \$65.90 inc. tax.  
BUILT & TESTED \$80.00 inc. tax.**

**RITRON COMPUTER GRADE POWER SUPPLY: +5V Reg, 10A,  
+16V Unreg. Kit of parts \$79.95 inc. tax. A&T \$99.95 inc. tax.**

Write for list of other power supplies. Tax free prices also available.

### JUST WRAP KIT - JWK-6 \$39.50

• 50ft ea. blue, white, red, yellow wire • Just Wrap Tool • Unwrap Tool

**Perfect for  
OEM's**

### S-100 Z80 CPU CARD

**\$199.00  
Wired &  
Tested**

**4 MHZ**



**ASSEMBLED AND TESTED! READY TO USE!** Over 3 years of design efforts were required to produce a **TRUE S-100 Z80 CPU** at a genuinely bargain price!

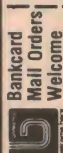
#### FEATURES

- ★ 2 or 4 MHZ Operation
- ★ Generates MWRITE so no front panel required,
- ★ Jump on reset capability
- ★ 8080 Signals emulated for S-100 compatibility
- ★ Top Quality PCB Silk Screened Solder Masked Gold Plated Contact Fingers

**BRAND NEW!**

**SHUGART 5" MINI FLOPPY DRIVE: \$379.50 inc. tax.  
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General enquiries (03) 489-8131, Mail order enquiries (03) 481-1436, Ritronics Wholesale (03) 489-7099. Prices current till 7th October, 1980. Heavier items add additional postage. Extra heavy items sent Comet freight on. Prices subject to change without notice. Send 60c and SAE for free catalogues. MAIL ORDERS PO Box 135, Northcote, Vic 3070. Minimum pack and post \$1.25.



## 10M hard disk is first for new microcomputer



The new Opal microcomputer system, just released here by John F. Rose Computer Services, is believed to be the first S-100 microcomputer to incorporate an SA 1004 10M hard disk by Shugart.

**Manufactured by NNC Electronics of Huntington Beach, California, the Opal employs a Z80 microprocessor and features an 8-slot S-100 system.**

The CPU card is by Delta Products and runs at 4 MHz. It incorporates two RS232c serial ports and three fully buffered 8-bit parallel interface ports.

The unit comes fitted with a 4 MHz 64K dynamic RAM board, by Measurement Systems and Control, fully bank selectable and designed for upgrading to a multi-user system.

In addition, you get one 8" (uh, 203 mm) Shugart floppy disk drive of 240K capacity with a Delta Products Disk Controller and CPM version 2.2 operating system. Price? — only \$7700!

You can order single or multi-user configurations. For multi-user use, the Opal comes with 128K of RAM plus MPM set up for two users. You get two serial ports set up for two users and one of the parallel ports for

a printer. All for \$9345 plus the inevitable sales tax (if applicable).

John F. Rose is also releasing an Ampex "5 + 5" top-loading hard disk cartridge system. (Five megabytes fixed and five removable). This, together with MPM and CPM software, hard disk controller S100 interface and timber desk top case — fully set up for any Opal system — is expected to cost around \$8500.

While we're at it, John F. Rose also has available an SMD hard disk controller capable of handling up to 600M on line!

We were fortunate to see a first-shipment Opal demonstrated by NNC Electronics' "big chief", Alexander 'Sandy' Watson, just before going to press. File management was impressively fast and it can sure play a mean game of 'Adventure'.

Further details from John F. Rose Computer Services, 33-35 Atchison St, St. Leonards NSW 2065. (02)439-1220.

## Light pen for System-80

**A new low cost light pen designed for use with the popular System-80 microcomputer has been released by Dick Smith Electronics along with suitable software.**

Designated Cat. No. X-3645, the new light pen replaces an earlier imported product sold under the same number which had become unavailable. The new pen is being locally assembled and is also being sold separately from the software. This has enabled a drastic price reduction: the pen itself, sold with instruction brochure, now sells for only \$95.

Two demonstration software programs are available on cassette tape as a separate product. One program is a 'naughts and crosses' game, while the other provides a sample 'menu selection' routine. The two come together on cassette as Cat. No. X-3647, which sells for \$11.95. So the X-3645 light pen and X-3647 software cassette can

both be purchased for a total of \$21.90 — a saving of no less than \$7.60 compared with the earlier product. The light pen is compatible with the TRS-80 Level II, also.

DSE is also offering SKETCH-80 which can be used with the new light pen to 'sketch' diagrams, patterns and other graphics directly on the System-80 video screen. Designated Cat. No. X-3646, SKETCH-80 comes on a tape cassette with accompanying instruction booklet and sells for \$17.95.

The new light pen and accompanying software products are available from Dick Smith Electronics branches in each state.







## Beehive Burroughs emulator

**Datatel has released a new microprocessor-based communications terminal by Beehive International, the Micro 4400.**

The Beehive Micro 4400 does not require a controller as it emulates Burroughs' TD 700/800 series terminals and enhances Beehive's DM series product line array of smart terminals.

For custom OEMs, the Micro 4400 features the ability to support special protocols conforming to particular applications and offers variation of known protocols.

Features include: large displayable character set, upper/lower case, numeric keypad, printer interface, detachable keyboard, scrolling, background printer operation, line drawing capability, and program attention/programmable function keys.

Another outstanding feature claimed for the unit is its unique printer control capabilities. The

Micro 4400 supports both serial and parallel interfaces, as well as local and communications printers on a concurrent basis.

In a polled environment the printer address may be shared or independent of the terminal group address.

The basic Micro 4400 is supplied with 16K of RAM which may be expanded to 32K. The RAM is used for display (up to 120 lines accessed by scrolling), I/O printer data and 16 user-definable function keys.

The hardware has been specifically designed to allow extensive checking by the self test diagnostic and thus provides the operator with a high level of confidence in the terminal.

For further information, contact: Datatel Pty Ltd, 3 Raglan Street, South Melbourne Vic 3205. (03) 690-4000.

## Tasmanian societies

**The Darrh Amateur Computer Society writes to tell us that their name has been changed to the Tasmanian Electronic and Microcomputer Oriented Society (or TEMOS). Only the name has changed, everything else is the same.**

Unfortunately, last time we mentioned this group we misprinted their address. The correct address is 4, Melinga Place, Taroona, Tas. 7006. Sorry!

And we've just heard about the **Small Computer Users Group**, which meets on the first Tuesday of each month at 7.30 pm at the Computer Centre, Elizabeth Matriculation College, North Hobart. Anyone interested should phone Steve on 23-2211 or write to P.O. Box 474, Sandy Bay, Tas. 7005.

## Zilog offers 6 MHz Z8000

**A faster version of the advanced Z8000 16-bit microprocessor circuit has been announced by Zilog which will run at a clock rate of 6MHz, a 50 percent improvement over the 4MHz rate of the earlier version.**

The 6 MHz Z8000 is available in two package types for different applications. The segmented Z8001A, in a 48-pin dual-in-line package, permits the user to address up to eight megabytes of memory for highly memory-intensive applications. The non-segmented 40-pin Z8002A allows addressing of 64 kilobytes of memory for less memory-intensive uses.

When used with Zilog's Z8010 Memory Management Unit, the Z8001A can offer high performance and a memory addressing range of up to 48 megabytes.

According to Janak Pathak, the Z8000 product marketing manager, the 6 MHz Z8002A is

ideally suited for use in high-speed controllers; the Z8001A has applications in the design of new systems requiring higher system throughput, such as distributed processing systems.

The Z8001A is priced at \$21.25 and the Z8002A at \$187.50 each in quantities at 10-99. Both devices, which come in ceramic dual-in-line packages, will be available in sample quantities in the third quarter of 1980, and in small production quantities by the fourth quarter.

For further information please contact Zilog Australia Products; Sydney (02) 438-4533, Melbourne (03) 656-1420, Brisbane (07) 36-3396 and Perth (09) 272-6611.

## Single board video terminal

**With everything but the CRT and the power supply packed in, the KTM-2 from Synertek provides a complete video terminal on a 406 x 172 mm board.**

The new terminal board offers a 54-keyboard 24 x 40 (Model KTM-2) or 24 x 80 (Model BTM-2/80) character display generation with full ASCII upper and lower case characters and descenders, and 128 graphics characters.

In addition, the board does scrolling and reverse and performs full cursor control as well. To do all this, the KTM-2 uses two microprocessors, instead of a CRT controller chip.

Two RS232-compatible serial ports operate from 110 to 9600 baud. If TTL serial levels are required, all the board needs is a 5 V supply capable of delivering from 1 A.

Other standard board features include switch-selectable 50 Hz or 60 Hz operation, composite video or discrete video outputs, display scrolling, absolute or relative cursor addressing interface/no-interface, and operating models by charac-

ters, line or page. Also local editing with character insert/delete, line insert/delete, erase screen/line, transmit page/line, truncate/not-truncate at end of line, four levels of character intensity, auxiliary RS232 port for printer interface etc.

The BTM-2 can readily be customized for any application just by changing the program ROMs. Both the character set and the key functions can be altered since the basic 54-key matrix is simply scanned by one of the microprocessors and the key functions are defined by the software.

According to distributors Royel Micro Systems, the combination of high capacity and low cost puts the KTM-2 well out in front of most well known terminal units.

Literature is available from Royel Micro Systems, 27 Normaby Road, Notting Hill Vic 3168. (03) 543-5122.



# WHY IS THIS AUSTRALIA'S FASTEST SELLING COMPUTER?



## Simple. It is far and away the best value computer available in Australia

We admit it: Australia's fastest selling computer **was** the TRS-80. Was. It has now been well and truly beaten by the remarkable System 80 from Dick Smith Electronics. It has TRS-80 compatible level II BASIC **as standard**. So the huge software range which has been written for the TRS-80 is compatible! Not only that, it has S-100 bus expansion capability: so the huge range of S-100 hardware will be useable on the System 80!

- **Level II compatible BASIC as standard**  
(Tandy charge extra for level II)
- **Industry standard S-100 bus expansion**  
(They use their own non-standard system)
- **RF output: uses any TV set as a monitor**  
(You have to buy a true video monitor with theirs)
- **Two motor controlled cassette interfaces**  
(Theirs only has one)
- **Inbuilt cassette deck (no inter-connections necessary)**  
(Their cassette deck is completely separate)
- **Inbuilt power supply (no inter-connections)**  
(Tandy power supply must be connected up)
- **AND THE BEST PART OF ALL: IT IS MUCH CHEAPER THAN THE TANDY EQUIVALENT!**

Send for our **FREE** Computer Comparison Chart

## DICK SMITH SYSTEM 80

**4K RAM WITH LEVEL II BASIC**

Cat X-4003

**\$670<sup>00</sup>**

**16K RAM WITH LEVEL II BASIC**

Cat X-4005

**\$750<sup>00</sup>**

Terms available to approved applicants

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**ACT** 842 Gympie Road, CHERMSIDE. Ph 59 6255  
**SA** 96 Gladstone Street, FISHWICK. Ph 80 4944  
**WA** 60 Wright Street, ADELAIDE. Ph 212 1962  
414 William Street, PERTH. Ph 328 6944



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PRODUCTS IN MOST AREAS OF AUSTRALIA.

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## EPROMS make excellent loggers

Erasable PROMs have proved very successful and reliable for unattended data logging in remote areas.

**Their most successful application so far is in automatic rainfall recorders, which used to present a tricky problem.**

Because rain comes only rarely in the outback, continuous chart recorders are impracticable — they would generate vast amounts of blank paper or magnetic tape during the long dry spells. But a sampling recorder could easily miss the typically brief periods of intense rainfall — and still waste a lot of paper.

The DRF77 rainfall recorder, developed by Measuring and Control Equipment (MACE) for the Sydney Water Board, neatly solved the problem by using an EPROM to record the instant when a water collecting cup fills with an inch of water and tilts, closing a contact.

A quartz crystal oscillator updates a 16-bit register every minute or two minutes. When the tilting cup contact closes, the contents of this register are programmed into a 2716 or 2732 EPROM. The EPROMs are contained in modules that plug directly into the recorder and the same plug can be used to

match the module to a computer or graphic plotter. Once read, the EPROMs can be easily bared for erasure and covered for re-use.

The units only draw significant power when they are actually recording an event so only a small power supply is needed — a 12 volt 900 milliamphour battery which can be recharged by solar cells. They will run completely unattended until either the EPROM has stored 4095 events or the timing register overflows, which happens after 45 days with one minute resolution, or 91 days with the two minute timing interval.

DRF77s have been in operation for around three years now and over a hundred instruments are in the field. MACE also use EPROMs for recording analogue quantities such as river levels. They are now updating their system to use the latest 64K EPROMs and a low power multichannel microprocessor version is under development.

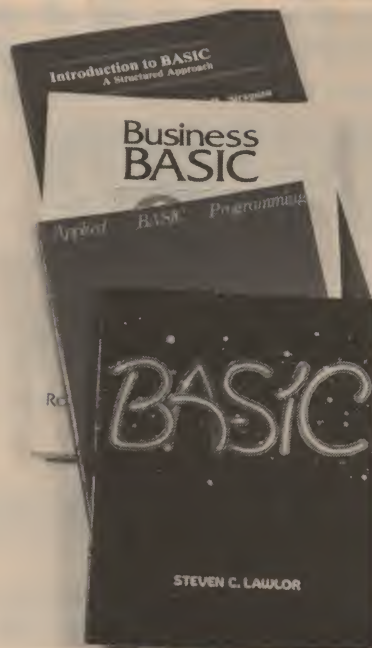
More information from Measuring and Control Equipment Co. Pty. Ltd., 24 Chester St, Epping, NSW 2121. (02) 86-4060.

## Wizard matrix printer

**The NDK S4000 dot matrix printer, recently released by John F. Rose Computer Services, can print subscripts, superscripts and scientific or mathematical symbols.**

Featuring a 16-wire head, this machine can handle most paper widths, variable size characters, user-defineable characters and overprinting. The distributors claim the S400 has 2000 hours mean time before failure and you can obtain one for \$3105 (plus S/T), complete with six month warranty.

See John F. Rose Computer Services, 33-35 Atchison St, St Leonards NSW 2065. (02)439-1220.



## Getting down to BASICs

Have you always wanted to know about BASIC but were afraid to ask? Banish embarrassing ignorance with one (or more) of four books reviewed here by Elaine Ray.

### **Introduction to BASIC — A Structured Approach** **Chris R. Siragusa**

A good book for beginners. Mr Siragusa assumes no previous knowledge of the subject, only an interest in computers and a knowledge of High School algebra. He begins with a resume of the history of computer science and advances step by step to the final chapter on debugging techniques. The book is well designed, with excellent graphics, flowcharts and structural programming information.

### **Business BASIC** **Robert V. Bent and George C. Sethoris**

This is great for the first time business user with no previous computer or programming experience. There's a brief look at hardware and software, leading on to exercises in problem solving and the first program. Small business users who have ingested the contents of this book will be able to converse on much more equal terms with slick salesmen and white-coated experts.

### **BASIC** **Stephen C. Lawlor**

A really comprehensive guide to the subject that should answer every question you're likely to ask. The instructions and flowcharts are clear and the examples are realistic and credible. The glossary is first rate — every piece of computer jargon you're likely to come across is listed with a concise definition.

### **Applied BASIC programming** **Roy Ageloff and Richard Mojena**

This is best described as an in-depth course for those who already have a little knowledge of the subject. Topics covered include the impact of the computer, computer systems and perhaps the most delightful chapter of all, 'Before You Leap'.

If you want to know more about any of these books, you can write to Michael Smith, manager of the Wadsworth Publishing Company (A'Asia), P.O. Box 278, Artamon, NSW Or phone (02)439-8781.



# WOW! SOUND EFFECTS FROM YOUR SYSTEM 80!

(Also suitable for TRS-80 Level 11)

## SOUND OFF!

Yes! At last there is an add-on sound effects generator for your System 80 or TRS-80 level II computer. It will give you exciting music synthesis and sound effects facilities that you haven't had before!

Add another exciting dimension to your computer with this superb system.

Here's what you get:

- A battery powered amplifier unit which connects to the 16K System 80 or TRS-80 computer via the normal external cassette recorder cable.

A software cassette, which tells the computer how to manipulate its cassette interface. On one side of the cassette is a sound effects demonstration program; on the other a 'patch' program, designed so that the user can combine sound effects with almost any other BASIC programs!

- Plus a very comprehensive 8 page user's manual to tell you what is going on, and how to change the system to suit your particular requirements.

**Hurry! Limited stocks available at present!**



**'SOUND-OFF' PACKAGE:**  
Includes amplifier module, software cassette and very comprehensive user manual:

**ONLY \$19<sup>50</sup>**

Cat X-3648

**STOP PRESS**

**GREAT NEWS for System 80 and TRS-80 owners . . .**

**We can now offer the lowest cost light pen EVER!**

**\$9<sup>95</sup>!!!**

Cat X-3645

Due to the incredible popularity of these light pens we're now getting them assembled locally - you reap the benefit of lower production costs!

So now you can give your System 80 or TRS-80 Level II an 'eye', for even less than before . . .

- Uses external cassette recorder as a preamplifier
- Comes complete with full instruction details, how to get your programs to use the pen, etc.
- Save time! Uses matching software cassettes, also available:

**Demo Cassette:** Has noughts and crosses game, sample 'Menu' program. Cat X-3647 **\$11.95**

**SKETCH 80:** Lets you use the light pen to 'sketch' on the screen! You can also save 'sketches' in memory. Cat X-3646 **\$17.95**



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656 Bridge Road, RICHMOND. Ph 428 1614  
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## Printer interface for System-80

**A low cost parallel printer interface for the System-80 microcomputer has been announced by Dick Smith Electronics. The interface plugs directly into the expansion connector on the rear of the basic System-80 machine and provides all of the interfacing logic necessary to drive a Centronics-type parallel printer.**

It is intended specifically for low-end applications, where the full facilities of the System-80's S-100 Expansion Interface are not required, nor its cost justified.

The new interface is designated as Cat. No. X-4012, and sells for \$89.50. It comes complete with instructions and a printer interconnection cable, terminated in the standard 57N-36 connector used with most printers having a Centronics-type parallel input.

For those without a suitable printer, Dick Smith Electronics

also offers the X-3255 dot-matrix printer, a compact 125 character/second model priced at \$970.00.

No special software is required in order to use the X-4012 interface and a printer with the System-80 computer, as the machine's inbuilt Level-II Microsoft BASIC interpreter already provides the necessary LLIST command and LPRINT statement.

The X-4012 Printer Interface is available from Dick Smith Electronics branches in each state.

## Mod. for BASIC ROMPAC

**There is now a better way available to write programs for the Exidy Sorcerer with a new "extended" version of the Exidy BASIC ROMPAC.**

The new BASIC comprises a hardware modification to an existing ROMPAC and the exchange of two ROM chips.

The language becomes considerably more powerful with the addition of full line editing and block deleting functions along with a fully selective renumber function. This allows the complete restructuring of a program without destroying its integrity.

Programs can be instantly recovered after a reset (remember the program you lost after that mains spike?). In addition, most of the known bugs of the original have been fixed, according to Software Source, the firm marketing the mod.

Software Source, of P.O. Box 364 Edgecliff NSW, call it "Basic Mod 1.01" and market it on an exchange basis as a fully-assembled and tested unit, or as a two-chip hardware kit with instructions.

## Interface for System-80 has floppy disk controller & I/O ports

**An Expansion Interface unit for the popular System-80 microcomputer has been announced by Dick Smith Electronics.**

The interface plugs directly into the expansion connector on the rear of the basic System-80 machine, and provides all of the interfacing necessary to provide the machine with up to four mini-communication busses as well as two vacant S-100 sockets which allow the system to be expanded even further.

Designated as Cat. No. X-4010, the new expansion unit sells for \$575.00. This includes an inbuilt power supply and all required interconnection cables.

Basically, the expansion unit consists of a three-slot S-100 card cage, motherboard and power supply in an enclosure which matches the case of the System-80 computer. Along with these comes a single, large S-100 card, providing a complete floppy disk controller along with the interfacing required for the S-100 buss, a Centronics-type parallel printer port and a bidirectional RS232C serial port.

The floppy disk controller uses one of the latest LSI dedicated controller chips and is capable of controlling up to four standard single-density 14 cm (5-1/4in) drives. The X-3230 drives sold by DSE for \$379 each (less power supply) are suitable, and four of these drives will provide the System-80 with more than 800K of storage capacity. Power supplies capable of powering up to two of the X-3230 drives are available (Cat. No. X-3234) for \$60 each.

A software disc operating system (DOS) specifically designed to suit the System 80 will be available shortly, although a number of the currently available DOS packages will run on it quite satisfactorily.

The parallel printer port on the new expansion unit has all

floppy disk drives, a Centronics-type parallel printer and communication facilities using an RS-232C asynchronous serial I/O port.

The unit also provides full interfacing to the standard S-100 logic necessary to drive a standard Centronics-type printer, while the printer cable supplied is terminated in standard 57X-36 connector. It is thus eminently suitable for use with the 125 character/second dot matrix printer sold by DSE, the X-3255.

The RS232C serial I/O port provided by the unit may be set by DIP switches to any of 10 standard and crystal-derived baud rates between 110 and 2400 baud. It may also be set for any standard data format (number of data bits, number of stop bits, parity etc). The port is also provided with all standard "handshaking" logic.

A unique and added feature of the expansion unit is that if the user has a serial printer (such as a surplus teleprinter), this may be used in place of a parallel printer of BASIC listings and printing using the standard LLIST and LPRINT commands. This is achieved merely by setting two further DIP switches — a very handy facility not found on comparable systems, according to Dick Smith.

An obvious use for the spare S-100 card slots in the new expansion unit is for expansion of the System-80's RAM memory capacity. Suitable memory expansion cards will be available shortly, offering either 16K or 32K bytes of extra memory. This will allow the System-80 to be expanded to a fully-blown system with 48K of RAM.

The X-4010 System-80 Expansion Unit will be available shortly from Dick Smith Electronics branches in each state.





## THE 1980 HOME COMPUTER SHOW

The major micro-event of the year. Computers in the home will soon be as common as HiFi and TV. Come to the major Home Computer Exhibition in

- Personal Computers
- Processors

Business Systems  
Games and Gadgetry

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Cotham Road, Kew.

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Friday, Sept 12, 10.00a.m.-6.00p.m.

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Sunday, Sept 14, 10.00a.m.-6.00p.m.

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## Bye Bye, Bogong.

The aborigines hunted it. The settlers grazed it. The prospectors claimed it. The timber getters got it. The engineers dammed it. What's left for a national park?

**"I was hit by a fridge at 25 mph."**

When your campervan stops, does everything inside stop, too? August Overlander looks at a van that's a wreck. Inside. And ways of making sure it won't be your van.

**Overstocked, Overworked,  
Undermanaged, Undermined.**

Overlander's policy on the Environment. It won't make everyone happy. But it does make sense. September Overlander. Because there's an Australia outside the city.



# overlander



# HARDWARE & SOFTWARE

## From DICK SMITH



Cat. X-3001  
**SORCERER**  
Cat. X-1196  
**MONITOR**

### PROFESSIONAL DAISY WHEEL PRINTER FOR WORD PROCESSOR SYSTEMS

This superb unit is a self-contained printer with in-built asynchronous serial interface conforming to the established RS-232C standard. It prints on business stationery up to 380mm wide at the rate of 45-65 characters per second - three times faster than golf-ball typewriters. Top quality office systems printer that is below competition prices.

**\$3,390.00**

Cat. X-3260

### EXIDY S-100 BUS EXPANSION UNIT

The way to go if you want extra versatility from your Sorcerer.

**\$575**

Cat. X-3010

● Allows up to 6 plug-in cards ● Connects directly to Sorcerer's S-100 expansion socket via supplied cable ● All S-100 lines fully buffered ● Separate 2.000MHz crystal clock provided for S-100 cards which cannot use the  $\phi 1$  and  $\phi 2$  clock signals derived from the Sorcerer's 2.106MHz clock ● Provision for mounting up to six 25 pin "D" connectors for additional I/O ports, etc.

### THE SORCERER

The Sorcerer is the expandable Z-80 based microcomputer that allows you to add peripherals to take it from basic computing through to advanced office business systems.

● 16K RAM expandable to 48K (on board) ● Serial I/O and Parallel I/O ● S-100 BUS compatible ● Cassette I/O for two recorders at speeds of 300 or 1200 baud ● Video I/O - 1920 characters full screen ● Full ASCII 128 characters (64 defined characters and 64 undefined characters) ● Graphic resolution 122,880 pixels ● Includes 8K BASIC plug-in ROM PAC™ in MICROSOFT™ ● Dimensions 490 x 330 x 100mm ● Weight 6 kilograms.  
(Ask for our FREE comparison chart between the Sorcerer and other well known computer brands).

Dust cover to suit  
Cat. X-3005 **\$5.95**

**\$1,395.00**

### VIDEO MONITOR

This is a superb 30cm black and white video monitor that can be used on AC and DC. Simple connection to your computer. Features jitter free and distortion free characters. Can be used with most computers on the market.

Cat. X-1196

**\$149.50**

### WORD PROCESSOR PAC

Remove the plug-in BASIC PAC™ and replace it with the powerful WORD PROCESSOR PAC™ and you will have the basis of an office computer system.

Features: ● Automatic text wrap ● Automatic checking of drastic commands ● Powerful search function ● Auto commands ● Macro programming - all this plus extensive user instructions.

Cat. X-3085

**\$275.00**

### FAMOUS 'BLUE BOARD' PLUG-IN CARD MODULES FOR THE S-100 BUS...

And now for the famous 'Blue Boards' from SSM in the US of A. Three boards available for your S-100 unit in ready built form or as kits with comprehensive instructions.

#### 2 PARALLEL & 2 SERIAL I/O BOARDS

Built unit Cat. X-3300 **\$250.00**

Kit form Cat. X-3301 **\$190.00**

#### MUSIC SYNTHESIZER BOARD

Built unit Cat. X-3305 **\$310.00**

Kit form Cat. X-3306 **\$250.00**

#### 8K & 16K PROGRAMMER & 4K/8K EPROM BOARD

Built unit Cat. X-3310 **\$250.00**

Kit form Cat. X-3311 **\$190.00**

### SORCERER BOOKS

A new series of books containing programs that will make your Sorcerer even more versatile!

Small Business ..... Cat. B-6110 ..... **\$49.95**

Educational & Scientific .... Cat. B-6112 .... **\$37.95**

Fun & Games No. 1 ..... Cat. B-6114 ..... **\$17.95**

Fun & Games No. 2 ..... Cat. B-6116 ..... **\$17.95**

Home & Economics ..... Cat. B-6118 ..... **\$27.95**

Fantastic value for anyone with a Sorcerer

**SEE THE OTHER DICK SMITH ADVERTISEMENTS IN THIS PUBLICATION FOR STORE ADDRESSES AND PHONE NUMBERS**

### LIGHT PEN FOR SYSTEM 80

**\$9.95**

Fantastic light pen for use with your TRS-80 or System 80 computer. Uses **ALSO FOR TRS-80** your cassette player as a preamp. Complete with plug & battery snap. Use with program tapes below.

#### NOUGHTS & CROSSES

Just insert this program cassette into your computer cassette player and enjoy playing the game with your light pen.

Cat. X-3647

**\$11.95**

### MICROPOLIS™ QUAD DENSITY DISC DRIVE

The Micropolis mod 2 drive with controller enables you to store 315,000 bytes on just 1 disc. By adding the mod 2 add-on drive (up to 3) you can obtain up to a maximum of 1.25 Megabytes! Complete with all software to enable you to be up and running in a very short time.

Model 1043/mod 2 with controller.

Cat. X-3205 **\$1,350**

Model 1023/mod 2 add-on

Cat. X-3208 **\$750**

### SOFTWARE FOR SYSTEM 80 and also the TRS-80

#### TIME TREK

Hunt the Klingons through space and fight an intergalactic war. Has nine levels of play. (4K level I and II).

Cat. X-3650 ..... **\$17.95**

#### STIMULATING SIMULATIONS

10 games on one cassette from monster chase to nautical navigation and lost treasure. (4K level I and II).

Cat. X-3652 ..... **\$17.95**

#### ELECTRIC PAINTBRUSH

Create dazzling real time graphics. Commands let you draw lines, turn corners, change white to black, repeat previous steps or call other programs. (4K level I and II).

Cat. X-3654 ..... **\$17.95**

#### BLOCKADE

Many variations whereby you and your opponent try and make each other collide with a wall. (4K level I and II).

Cat. X-3659 ..... **\$17.95**

#### BRIDGE CHALLENGER

Practice and improve your game of Bridge. (16K level II).

Cat. X-3656 ..... **\$17.95**

#### MICRO CHESS

The computer is programmed to beat you at chess and you are trying to beat it - absorbing & educational.

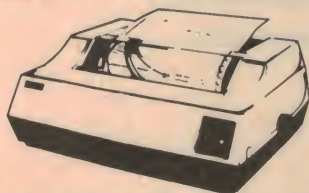
Cat. X-3658 ..... **\$22.50**

#### SIMUTEK 1

Contains 5 games that would normally cost \$19.50 each! Great fun for all the family and friends. (4K level I and II).

Cat. X-3685 ..... **\$17.95**

### C.I.TOH BRAND DOT MATRIX PRINTER



The model 8300P dot matrix printer is a nonsense unit that can churn out the full 96 character ASCII at a brisk 125 characters per second on standard fan-fold paper. Character spacing of 80, 40 or 132 columns which are software selectable. A quality unit that costs less than \$1,000!!

Cat. X-3255

**\$970.00**

### JABEL COMPUTER MAINS FILTER

Having trouble with memory crashes? Then the answer is the Jabel Mains Filter - it will remove those annoying spikes from the 240V mains and thereby protect your memory!

Cat. M-9850

### DYNAMIC EXPANSION KITS

These are top quality ICs that can expand your basic 16K Sorcerer to 32K or even 48K (expands the 8K to 16K etc). They can also be used with the TRS-80 level I and II and the Apple II computers to expand their on-board RAM. Superb value and complete with installation instructions.

**SAVE NOW \$79**  
**\$30.50** Cat. X-1186

### SOFTWARE FOR YOUR SORCERER MARTIAN INVADERS

Similar to the very popular 'Space Invaders' you find in amusement parlors.

Cat. X-3626 ..... **\$17.95**

#### NIKE II

Fight off bombing attacks with your missiles and protect the city from heavy casualties.

Cat. X-3627 ..... **\$14.95**

#### TANK TRAP

Render the marauding tank harmless but watch out for slow drying cement and unarmed citizens!!!

Cat. X-3628 ..... **\$14.95**

### NEW NEW NEW DUE IN SHORTLY COGNIVOX™

VOICE INPUT & OUTPUT FOR THE SORCERER

★ Recognizes up to 16 words.  
★ 16 word voice response vocabulary  
★ Easy two pass training  
★ Up to 98% recognition accuracy  
★ Generates music & sound effects  
★ Excellent software support  
★ Connects directly to Sorcerer

Cat. X-3150 ..... **\$199**

### C10 COMPUTER CASSETTE

Dick Smith special grade cassette tape with 5 minutes per side and 38K capacity per side.

Cat. X-3500 ..... **\$1.95**

### SKETCH 80

For the System 80 and TRS-80  
A program tape that allows you to sketch on your VDU - the light pen becomes a real writing tool!!  
SEE LIGHT PEN ABOVE

Cat. X-3646 ..... **\$17.95**





# WIN A DICK SMITH SYSTEM-80 COMPUTER !

Two — yes, two ! — Dick Smith System-80 computers to win. You can win one for yourself or one for your school by entering this simple contest.

The Dick Smith System-80 has the following features:

- Level II compatible BASIC standard
- Industry standard S100 buss expansion
- RF output: you can use any standard TV set as a monitor
- Two motor-controlled cassette interfaces
- In-built cassette (no inter-connections)
- In-built power supply

The unit comes with 4K of random access memory (RAM) which can be expanded to 16K on board. The Dick Smith System-80 sells for \$615. A range of peripherals are available, including S100 buss expansion unit, light pen, printer and monitor. Peripherals do not come with the prize.

**Here's an excellent chance to obtain a System-80 for nothing !!!**

**This contest is jointly sponsored by ETI and Dick Smith Electronics — who have generously donated the prizes.**

You can specify whether you want to win one for yourself or for your school by ticking the appropriate box on the entry form.

You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand page of the contest. You must put your name and address where indicated on each entry form and tick one of the boxes showing whether you want the prize for yourself or your school.

**NOTE: Please read contest rules carefully, especially if sending in multiple entries.**

## RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Dick Smith Electronics, Modern Magazines (Holdings) Ltd, K.G. Murray Ltd, Australian Consolidated Press, Wilkes Pty Ltd and/or associated companies.

Entries should be addressed to ETI System-80 Contest, Electronics Today International, 15 Boundary St, Rushcutters Bay NSW 2011.

Closing date for the contest is 31 October 1980. Entries received within seven days of that date will be accepted if postmarked prior to and including 31 October 1980.

The contest will be judged by the Managing Editor of ETI whose decision will be final. No correspondence can be entered into regarding their decisions.

In the event of one or more tied results occurring in the multi-choice questions amongst entrants, the finalists' entries will be judged on the written answer to the last question.

Winners will be advised by telegrams the same day the results are declared. The names of the winners, together with the winning answers will be published in the next possible issue of ETI.

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the right hand page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in States where local laws prohibit entries.

Entrants must sign the declaration accompanying this contest that they have read the above rules and agree to abide by their conditions.





Pascal's  
calculator

Pascal is generally credited with inventing the first digital adding and subtracting machine. It was based on number wheels linked by pin gearing and most of the wheels had ten divisions for decimal reckoning. The two wheels on the right hand side were different — one had twenty and the other had twelve divisions. Why? (Five points)

- To cater for sous and deniers ..... ☐  
 One was for shillings and one for pence ..... ☐  
 The builders made a mistake ..... ☐  
 So that hire charges for the machine could be calculated ..... ☐  
 The 'twelve wheel' handled months and the 'twenty wheel' was two 'tens' doubled up to save space ..... ☐

The first universal automatic calculator was conceived in 1833 by Charles Babbage, who worked on the design until his death in 1871. It had all the main features of today's electronic computers — memory, control, arithmetic unit and input/output. How much data was the memory designed to hold? (Five points)



Babbage

- 100 words of fifty digits ..... ☐  
 500 words of fifty digits ..... ☐  
 1000 words of ten digits ..... ☐  
 1000 words of fifty digits ..... ☐  
 10 000 words of five digits ..... ☐

Inspired by Babbage's ideas, a Swedish printer built a 'difference engine' which was displayed in London in 1854. This machine had four differences, calculated to the fourteenth digit and could print out its own tables. What was its inventor's name? (Five points)

- Pehr Scheutz ..... ☐  
 Georg Gutenberg ..... ☐  
 Hally Aller ..... ☐  
 Peter Ibsen ..... ☐

In 1947 Eckert and Mauchly designed a 'Universal Automatic Computer' UNIVAC). Apart from their operating principles and intent, UNIVAC and Hollerith's tabulating machine of 1889 had something in common in their original application. What was it? (Ten points)

In 1948 the British inventor M.V.Wilkes built EDSAC, the Electronic Delay Storage Automatic Calculator, which had an unusual method of storing data. What was this method? (Five points)

- Ultrasonics, using tanks full of liquid ..... ☐  
 Multiple cathode ray tubes and cameras ..... ☐  
 Mercury tilt switches ..... ☐  
 Morse code on gramophone records ..... ☐  
 100 000 Post Office type 3000 relays ..... ☐  
 None of the above ..... ☐

## ENTRY FORM

Unlike several competing systems the Dick Smith System 80 is S-100 buss compatible. What is the S-100 buss? (Five points)

- An internationally agreed system of interconnections enabling units such as computers, disk controllers, speech synthesisers etc. to be readily interfaced ..... ☐  
 A minimum packaging size agreed in 1976 ..... ☐  
 A means of stabilising mains voltage ..... ☐  
 None of the above ..... ☐

Dick Smith's System 80 is built around which microprocessor chip? (Five points)

- 8080 ..... ☐  
 Z80 ..... ☐  
 6280 ..... ☐  
 2650 ..... ☐

Does the System 80 have an inbuilt cassette recorder for data storage? (Five points)

- Yes ..... ☐  
 No ..... ☐  
 Maybe ..... ☐  
 None of the above ..... ☐

Please write not more than fifty words explaining why you (or your school) would like to win a Dick Smith System-80 computer.

.....  
 .....  
 .....  
 .....  
 .....

I want to win a Dick Smith System-80 for (tick one box only)

- ☐ myself  
☐ my school

Name .....

Address .....

.....  
 .....

..... Postcode .....

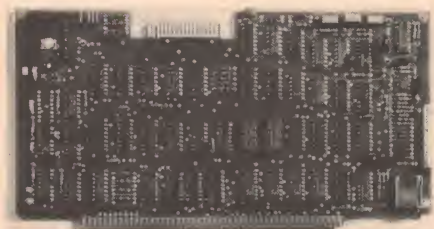
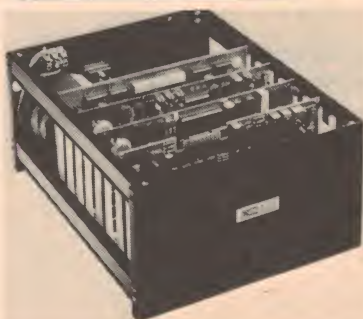
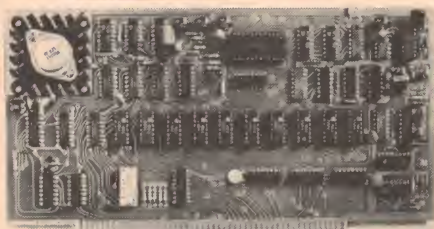
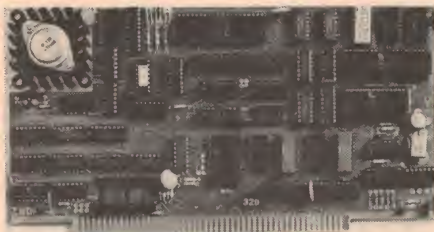
I have read the Contest Rules and agree to abide by their conditions.

Signed .....

Date .....



# Z80 BUDGET HOME COMPUTER ON S100.



Want to get started in home computing? Then the DGZ80 is an ideal product. Designed by David Griffiths and described in ETI. November 1979, the DGZ80/ETI680 is a powerful single board computer. Because its built on the S100 bus you can add other boards to build virtually any system you require. An ideal system for beginners is the DGZ80, DG640, keyboard, T.V. set and power supply and this can be readily expanded by adding more memory, I/O devices, printer, floppy discs as you need them. Because it is Australian designed and supported, you have full technical backing and of course, the vast library of Z80 software is available world-wide.

## DGZ80 — CPU

A single board Z80 based CPU features on board PIO (dual 8 bit I/O), CTC (4 channel counter/timer), power on jump, provision for 2K ROM on board, 1K RAM (expandable to 2K). Sockets for all IC's, top quality solder masked PCB and comprehensive owners manual.

DGZ80 kit	\$199.25.	(\$175. tax exempt).
Assembled	\$240.00.	(\$215. tax exempt).

DGOS 2K Monitor for DG640 programmed 2516 with listing — \$40.00.

## DG640. VDU.

Described in ETI March 1978 the DG640 features 16 lines of 64 characters, upper and lower case with "chunky" graphics, crystal locked self contained T.V. scan circuits, top quality solder masked PCB with sockets for all IC's and comprehensive owners manual.

DG640 kit	\$149.50.	(\$130. tax exempt).
assembled and tested	\$159.50.	(\$140. tax exempt).

## TCT 16K S100 STATIC RAM.

The TCT 16K S100 RAM is Australian designed and supported features 4 independent addressable 4K blocks, 2114 low cost static RAMS, directly compatible with DGZ80, DG640. Supplied with sockets for all IC's, top quality solder masked PCB, owners manual and full service backup.

TCT 16K kit less RAMS	\$100.00	(\$95. tax exempt).
kit with 16 K RAMS	\$269.00	(\$245. tax exempt).
Assembled & tested	\$299.00	(\$275. tax exempt).

## CARD CAGE/MOTHER BOARD.

Designed to exacting specifications the JC100 mother board is a plated through PCB with 9 slots and provision for active termination on all lines. A ground plane on the upper (socket) side ensures reliable operation at all speeds. The JC200 card cage is anodized aluminium and is supplied in kit form with all card guides, predrilled supports and all hardware. Provision has been made to fit a power supply if required.

JC100 mother board	\$49.50.
JC200 card cage	\$49.50.
S100 Transformer. 8v @ 10A, 16v-Q-16v 2A	\$25.50.

## CLARE C70/MGP KEYBOARD.

Ideal for a most professional system the Clare C70 keyboard is the ideal choice. Outputs are available for fully decoded ASCII parallel or serial.

C70/MGP Keyboard	\$165.00 tax paid.	(\$150. tax exempt).
------------------	--------------------	----------------------

## MICROPOLIS 1043 DISC CONTROLLER.

If you need DISCS this is the ideal solution. Just plug in the 1043 controller board and connect the disc unit. Package includes QUAD DENSITY DRIVE, POWER SUPPLY, CONTROLLER, CONNECTING CABLES, SOFTWARE PACKAGE (in DOS, RES and 24K MICROSOFT BASIC).

1043/DISC PACKAGE.	\$1350.00 tax paid.
--------------------	---------------------

## Z80 SOFTWARE.

### MICROWORLD Z80 BASIC.

At last a powerful extended basic to use with the DGZ80 and 640 VDU. Requires 16K of memory at 0000 features floating point accuracy to 62 digits, full graphics, complete error messages and powerful edit function to correct errors. Of course, it has regular features such as GOTO, IF... THEN... ELSE, IN, OUT, PRINT, PEEK, POKE, etc. etc.

MICROWORLD Z80 basic Cassette with manual	\$32.50.
(if purchased with DGZ80 kit Special price \$15.00).	

### GAMES TAPE (1.)

Play TARGET, TREK on your DG640. Based on the original games by PROCESSOR TECHNOLOGY, these are sure fine ways of entertaining your friends for hours!

Z80 GAMES TAPE 1. Cassette.	\$14.75.
-----------------------------	----------

### ETI 681 PCG.

As described in ETI June, 1980, this PROGRAMMABLE CHARACTER GENERATOR will enable you to produce fine graphics with your DG640 VDU. Kit is supplied with all components, 2 joysticks, top quality PCB, owners manual and sample software.

ETI 680 PCG kit.	\$140.00.
------------------	-----------



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computer users —

# FANTASTIC OFFER ON FLOPPY DISKS

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	10-19	20-49	50-99	100+
133 mm (SS, SD)	\$4.95	\$4.39	\$3.99	\$3.29
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Both sizes can be mixed to qualify for the quantity discount.

Mail this coupon now and ensure delivery of your order before Christmas. Make out your cheque or money order to 'Dindy Disk Offer', don't forget to include post and delivery charges.

NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and ETI is acting as a clearing house only. Cheques or money orders should be made payable to 'DINDY DISK OFFER' and sent, together with the coupon (or a photostat or clear, hand-written copy of same), to Disk Offer, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011. We will then process your order and pass it on to Dindy who will send you the goods. Please allow up to four weeks for delivery.

## Packing and delivery

10-19	\$1.50
20-49	\$2.00
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100+	\$3.00

Floppy disks are the highly convenient magnetic media used for mass storage with minicomputer systems. Dindy Marketing (Aust.) Pty Ltd has made available a quantity of 133 mm (5") diskettes and 200 mm (8") floppy disks for ETI readers at special prices. These single-sided, single-density disks are manufactured in the USA and are identical to those marketed here by two large well-known electronics retailers.

Each precision coated disk is enclosed in a PVC jacket with a protective liner. This material has low frictional properties and resists mechanical shock and heat. Minute foreign particles are absorbed by the liner, leaving the disk 'clean' for optimum recording performance. The disk itself consists of oriented polyester coated with a uniquely formulated gamma-ferric oxide, encapsulated in a wear resistant binder providing minimum friction with maximum durability. The smooth, polished surface results in low head and pad wear and gives long performance life.

All stages of manufacture of these disks are carried out in environmentally 'clean' rooms and each stage is continuously monitored to ensure accuracy in accordance with rigid industry standards. Before being consumer packed, the specially coated material is tested for signal levels, modulation and resolution, and the disk certified free of errors.

## NOTE: Offer closes 13 November

**Money back guarantee:** Dindy offer to refund the purchase price in full if you are not completely satisfied and provided you return the goods within 14 days of receipt.

Send coupon to:  
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ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011

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Quantity ..... 133 mm ..... \$ .....  
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Packing and delivery: ..... \$ .....

TOTAL: \$ .....

(Disks may be mixed for quantity discounts)

Name .....

Address .....

..... Postcode .....

Cheque or money order .....

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4	9	6																	
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 Expiry  
Date ... / ... / ...

Signature .....



# Zenith gets it all together with the new Z-89 three in one desk top computer.

The All-In-One Computer brings you all the power and built-in peripherals needed for any business computing task—all in one compact, desk-top cabinet.

**C.P.U.** The popular Z-80 microprocessor gives you abundant computer power. Features include 48K of user RAM, and two serial I/O ports complete with standard RS-232 interfacing for printers and modems.

**V.D.U.** All terminal functions are controlled by a separate Z-80 microprocessor for significantly increased throughput. It never shares processor power with the computer as do most desk top computers. A crisp, clear video image reduces eye strain and an excellent keyboard layout and touch make data entry fast and easy.

**Disk Storage.** A built-in 5¼" floppy disk unit gives instant loading and fast access. An optional **Z-87 dual disk unit** in a separate housing provides an additional 200K bytes for enhanced merging, sorting and copying capabilities.

**Software.** HDOS operating systems software includes BASIC interpreter, 2-pass absolute assembler and a powerful text editor. The popular CP/M™ operating system runs on the **Z-89** allowing the system to be programmed in microsoft BASIC, FORTRAN, COBOL and others. Application software available includes word processing.



For further information contact WARBURTON FRANKI at any of the following locations.



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# Improvements to the AIM65 cassette interface

The Rockwell AIM65 is a popular and powerful 'naked micro' that has found its way into many hobby and professional spheres. If you have had difficulty with the cassette interface, this note will be of interest.

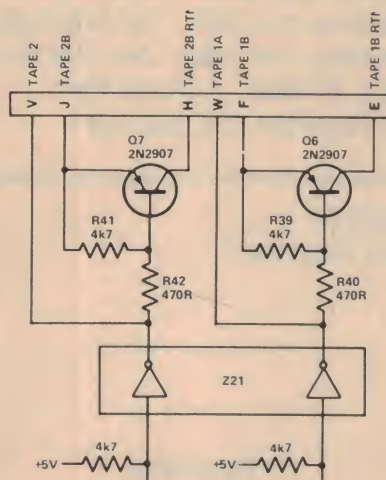
**A. Bendeli H.M.P. Stock** CSIRO Division of Applied Physics, Sydney NSW.

THIS NOTE may be of assistance to readers concerned with the use of the versatile AIM65 microcomputer system.

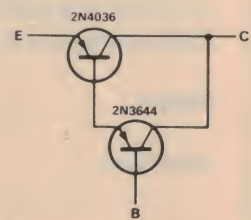
We have encountered some difficulty in interfacing the AIM65 to a "Realistic" (Tandy) CTR80 cassette recorder, in that, despite apparently normal recording signals, it was not possible to read back a short tape written by the AIM65 on the recorder. The problem was traced to the inability of the AIM65 cassette interface to switch the recorder reliably via the *remote* connection. The motor either would not start, or would start and then slow to a stop after about 10 seconds, then advancing sluggishly, or not at all. The fault was apparent on both *remote* channels.

The starting and running currents of the motor of the CTR80 are of the order of 900 mA and 150 mA, respectively. The gain of the 2N2907 switching transistor in the *remote* control of the AIM65 is insufficient for saturation to occur for the motor starting current. The motor supply voltage then appears across the 2N2907, which finally overheats. As a result, the motor is sluggish and eventually stalls.

We have removed the 2N2907 and replaced it with a Darlington pair constructed from a 2N3644 and a 2N4036. The 2N3644 has sufficient gain to drive the 2N4036 into saturation, while the motor starting current as well as the stall current are within the continuous rating of the 2N4036.



MANUFACTURER'S CIRCUIT



SUGGESTED MODIFICATION





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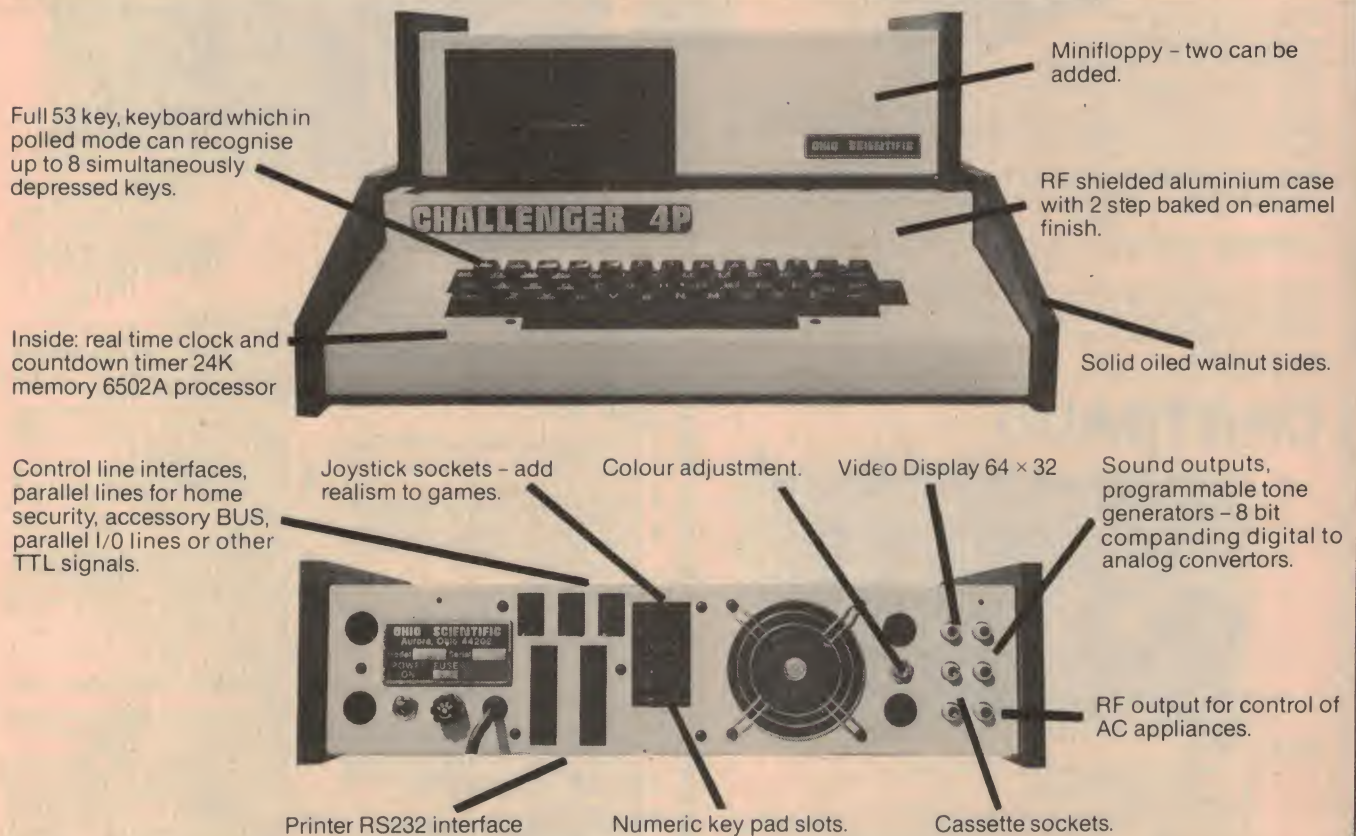
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For the complete list of dealers, please refer to listing on opposite page.

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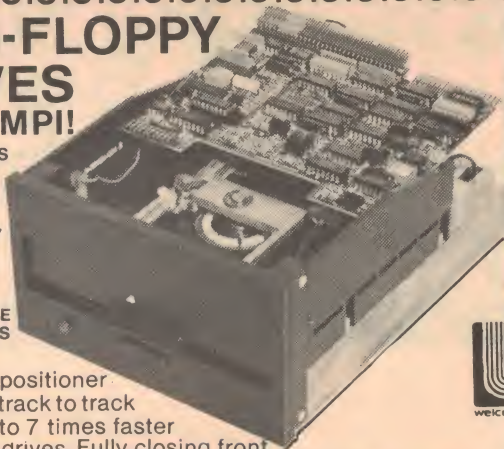
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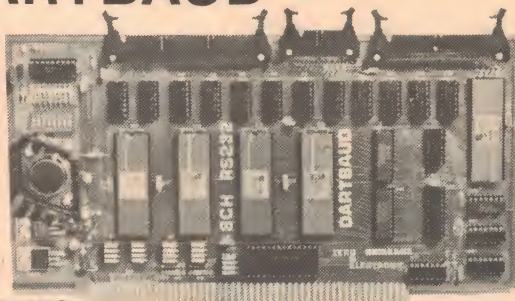
Head band positioner gives 5 ms track to track access — 5 to 7 times faster than other drives. Fully closing front door and 1/2" Clutch Cone for media protection, Double Density Heads, Shugart Compatible, only 10 moving parts due to non-mechanical switching.

**TWO MODELS** ● Model 51 Single Head 250k Bytes DD AVAILABLE ● Model 52 Double Head 500k Bytes DD

**PRICING:** 51 \$350.00 (402.50) 52 \$450.00 (517.50)  
Inc. tax. Inc. tax

Write or call for technical description. Power supply/case available May Since we are the Australian Distributors OEM discounts are available.

## DARTBAUD



### FEATURES:

- 8 Independently selectable I/O channels
- 2 Eight bit parallel ports
- RS-232 Interface levels
- Async or optional synchronous channels
- Baud rates 50-19,200 independently selected for each channel

### SPECIFICATION:

**Serial Ports:** 8 Independent ports using Zilog D/ARTs (sync) or optionally S10/0 (may be retrofitted for synchronous ports, for any pair (S10 and DART are dual devices).

**Baud Rates:** 6 Independent, crystal-controlled, software selectable rates for each port selected from the 16 standard rates between 50 and 19,200 baud.

**Parallel Ports:** 2 Independent ports using Zilog P10, selectable as either input or output.

**Interrupts:** Full on-board interrupt control provided. On-board devices daisy chained. Rotating priority control provided for running multiple boards (through top connector). Jumper selection of interrupt control (local, rotating, vectored). **PRICE: POA & MANUAL AVAILABLE**

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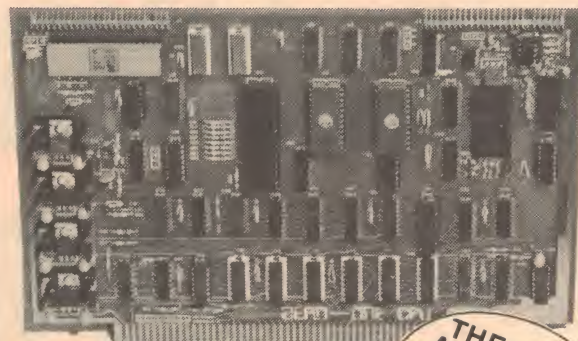
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## Can hams still contribute to communications art & science?

The answer is, emphatically — yes! Two well-known US amateurs, Doug DeMaw and Wes Hayward have had widespread influence on receiver design, according to a report in a recent issue of the US 'Electronics' magazine.

**Doug DeMaw, technical department manager at ARRL headquarters, organised a session at the prestigious Electro 80 conference on "Recent Developments in Communications Receiver Design".**

Neither man is a 'professional' in the field and the session's presence on the programme was considered to be as much a tribute to DeMaw and Hayward as to the timeliness of its subject.

The two hams' work has persuaded RF engineers to re-examine the design philosophy and circuits required to construct receivers for both amateur and professional applications. Commercial design goals now aim for high dynamic range and selectivity and low noise floor within an acceptable price. It took DeMaw and Hayward two years to be admitted to Electro 80, which is generally for industry professionals.

Chip Margelli, assistant Vice President of the US operation of the well known amateur equipment manufacturer Yaesu-

Musen, commented that the type of progress pioneered by DeMaw and Hayward was 'inevitable'.

DeMaw and Hayward, apart from developing state of the art receivers and publishing articles on the subject in QST, wrote a series on Solid State Design for the Radio Amateur which has been published as a book. Bill Sabin, engineer at Rockwell's Collins Radio Division, acknowledged the educational contribution of this book. It's recommended reading for Collins' junior engineers. He also said that, on occasion they have picked up some ideas from the work of DeMaw and Hayward.

Their book, published by the ARRL, is considered a 'landmark' text for those interested in actually building high performance equipment, as it contains practical information that is not found elsewhere in sources available to the professional or nonprofessional.

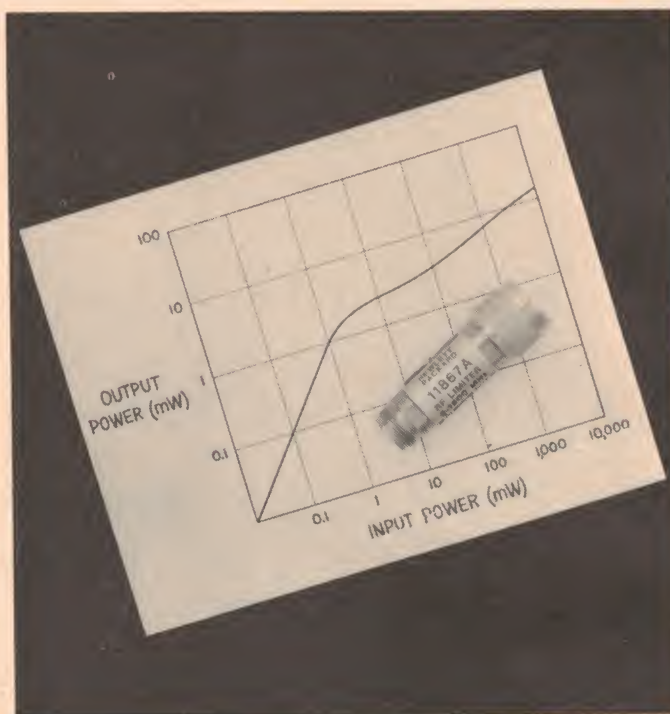
No mistake about it, hams can **still** make a significant contribution to the art and science of communications.

## Europe-Japan on 50 MHz!

**The first two-way contact on the 50 MHz band between amateurs in Japan and Europe is believed to have taken place on April 10 at 0012 GMT.**

Gibraltar station ZB2BL worked JA1BK in Japan with propagation over the 'long path' across South America. The great-circle distance is around 27 200 km, 17 000 miles. The opening lasted about 30 minutes in which time ZB2BL worked a number of Japanese stations.

Propagation was undoubtedly supported by the northern 'equatorial F-layer anomaly' being sufficiently dense to support 50 MHz propagation over a wide geographical extent.



## Broadband overload protection for RF instruments

**Sensitive RF instruments can be protected from overload damage with a new limiter, the Hewlett-Packard Model 11867A.**

The effect on lower-level measurements is minimum, typically introducing frequency response variations of less than 0.25 dB across the range dc to 1800 MHz.

Limiting action begins at signal levels around 1 milliwatt. Even with applied levels of 10 watts CW (or 100 watts peak), the output from the limiter stays well below 100 mW. Very often this can mean survival for an expensive mixer diode, sampling circuit, or amplifier front end, after inadvertent overloading.

One of the limiter's most at-

tractive performance characteristics, is that it does not constrict the dynamic range of sensitive instrumentation.

When the limiter is used ahead of the HP 8554B RF Spectrum Analyser, for example, the analyser's 70 dB distortion-free dynamic range is preserved for input signals below -40 dBm. The HP 11867A limiter is priced at \$248.

Further information from Hewlett-Packard Australia Pty Ltd, 31-41 Joseph Street, Blackburn, Victoria 3130. (03) 89-6351.



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FT-901D All-mode HF transceiver	D-2854	\$1175	\$135	\$34.96	48
FC902 Antenna Tuner (with WARC freq.)	D-2855	\$224	\$24	\$13.77	18
Memory Unit for FT-901	D-2858	\$139.50	\$15.50	\$8.53	18
FT-101Z HF Transceiver	D-2862	\$775	\$85	\$23.19	48
FT-7B HF Mobile Transceiver	D-2868	\$599	\$59	\$18.15	48
FT-707 Solid State HF transceiver	D-2869	\$735	\$75	\$22.19	48
FT107M 'The Ultimate' HF rig	D-2871	\$1278	\$138	\$38.32	48
FC-107 Antenna Coupler	D-2873	\$196	\$26	\$11.70	18
FC-707 Antenna Coupler	D-2875	\$157.50	\$17.50	\$9.64	18
FT-625 6 metre all mode transceiver	D-2886	\$695	\$75	\$20.84	48
FT-207R 2 metre microprocessor hand held	D-2888	\$358	\$38	\$17.52	24
FP-707 12 volt 20A power supply	D-2895	\$215	\$25	\$13.08	18

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Bankcard number, name and address, and we charge your Bankcard account. What is more, we'll send your new Yaesu anywhere in Australia for only \$6.00 road freight: that's below what it costs us!

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The disk operating system that gives:

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**ND-35+** ... .. \$99  
Newdos+ for 35 track drives

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#### LEVEL II ROM REFERENCE MANUAL

**\$24.95 plus \$1.20 p&p**

Produced in Australia by MICRO-80, this book is a must for the machine language programmer or for the BASIC programmer who wants to understand how the BASIC interpreter works. Over 70 pages packed full of useful information and sample programs. Applies to both TRS-80 and SYSTEM 80.

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## Where are Moscow's transmitters?

Even the most casual of shortwave listeners would have tuned in to Radio Moscow's broadcasts at some time.

**Radio Moscow, the overseas broadcasting service, has studios located in the USSR capital city, and broadcasts in a myriad of languages, using hundreds of high powered shortwave transmitters.**

Radio Moscow operates a 24 hour service in English also, known as the World Service, which is beamed to all parts of the world at peak listening times. For example, the World Service is beamed to Australia between 2000 and 1300 every day, on frequencies ranging from the 31 metre right through to the 13 metre band.

Although all programmes from Radio Moscow emanate from studios at Moscow, the transmitter you are tuned to is just as likely to be located at the Far East City of Vladivostok, or at the city of Dushanbe near the border with Afghanistan.

Radio Moscow uses trans-

mitters located throughout the entire USSR to broadcast their programmes world-wide. The size of the Soviet Union's territory enables Moscow to use transmitters at a location which will favour propagation to a particular target area. So Moscow can use transmitters in the Far East, at say Vladivostok or at Nikolayevsk, to beam programmes to Asia in our local evenings, when reception via transmitters in the western USSR may be unreliable in Asia.

Radio Moscow registers frequencies, together with sites, with the high frequency co-ordination body of the International Telecommunications Union (ITU) in Geneva, know as the International Frequency Registration Board (IFRB). Unfortunately, the Soviet bureaucracy and sheer enormity of Radio Moscow operations means the sites listed with IFRB for many frequencies are inaccurate.

Experienced DXers have discovered that they can hear broadcasts listed for sites which just could not propagate into their area. To hear a transmission on the 31 metre band in Melbourne, for example, at 0300, with a listed transmitter site of Vladivostok would clearly indicate that the transmitter was NOT located at Vladivostok at all but within the European part of the Soviet Union. The all daylight path from Vladivostok to Melbourne at 0300 would make reception of a 31 metre channel impossible.

DXers therefore have often made DXing the USSR their specialty. Publications are now available for DXers covering USSR broadcasting, compiled by DXers who have become very proficient in working out the sites used for Radio Moscow broadcasts.

One such publication is "UHN" — the USSR High Frequency Broadcast Newsletter,

published by experienced US DXer Roger Legge. Roger regularly lists Radio Moscow frequencies, with the IFRB registered site or site placed by Radio Moscow on QSL cards, and then the ACTUAL site, worked out by monitoring.

To show how Radio Moscow "listed" transmitter sites can be off-beam, a recent UHN showed that an often-listed Radio Moscow transmitter site, Frunze, located in Central Asia in the Kirgiz republic, has no towers of any kind of 200 feet in height. This strongly suggests Radio Moscow has NO transmitters located at Frunze at all! Some DXers may find this frustrating, while DXers of the Soviet scene find it fascinating.

Anyone interested in DXing the USSR could do worse than to enquire about receiving UHN via subscription. Write to Roger Legge, Box 232, McLean, VA 22101, USA, for details of subscription rates.

## Angola at its best

**Reception of stations in Angola is now at its peak, and these conditions should continue through to the end of September.**

Interest in DXing Angola is quite high due to the relatively large number of shortwave stations in this former Portuguese colony in west Africa.

The main station is located in Luanda, the capital, and announces as "Radio Nacional de Angola". Best reception is currently on 4820 and on 9535 during our mornings up to sign-off at 2359. The 60 metre outlet of 4820 is best prior to 2230, then begins to fade as the amount of daylight on the Angola to Australia path increases.

Meanwhile, the 31 metre outlet, 9535, tends to be best from 2230 up to close down, due to more powerful European and international stations leaving the frequency.

Best heard of the regional

stations currently is Emissora Provincial do Moxico at Luena in Moxico province. This station uses the out of band outlet of 5192, and so has interference free signals up to sign off at 2300. Reception usually peaks at about 2200, when the station relays the news from Luanda.

At present, the Angolan regional stations do not seem to be set up to answer reception reports. Should you wish to attempt to verify these stations, then it might be best to listen for the relays of Luanda programmes over the regionals, such as often occurs at 2200, and report reception to Luanda. The Luanda station presently will verify reports from DXers with a letter in English, although you may need to be patient and wait a few months for your reply.

## Spanish guide available

**DXers interested in reporting to the myriad of Latin American stations will gain great assistance from a new guide now available which sets out how to write a reception report in Spanish, the main language of Latin America.**

This "Spanish Reporting Guide" provides optional phrases in Spanish (together with explanations of their English meaning) which could be used to write a reception report to a Latin American station which does not answer reports written in English.

With reception of Latin American stations continuing to be good, especially on the 49 and 60 metre bands during our evenings here in eastern Australia, the "Spanish Reporting Guide" will be of great use to the keen DXer wishing to better his QSL tally from reports to the exotic Latin American stations.

The guide covers 20 pages

and includes an outline of the broadcasting scene in Latin America. You can obtain a copy for \$2 from the address in this column.

**NOTE!** All times are given in Greenwich Mean Time (GMT). To convert to Australian Eastern Standard Time, add 10 hours (11 hours for Daylight Saving Time). To convert to Central Time, add 9.5 hours and for Western Time add 8 hours. All frequencies are in kHz.

Shortwave Loggings is compiled by Peter Bunn on behalf of the Australian Radio DX Club (ARDXC). Further information on DXing or the activities of ARDXC may be obtained from — PO Box 79, Narrabeen NSW 2101, for a 30c stamp.



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Please contact

## AUDIO DESIGN

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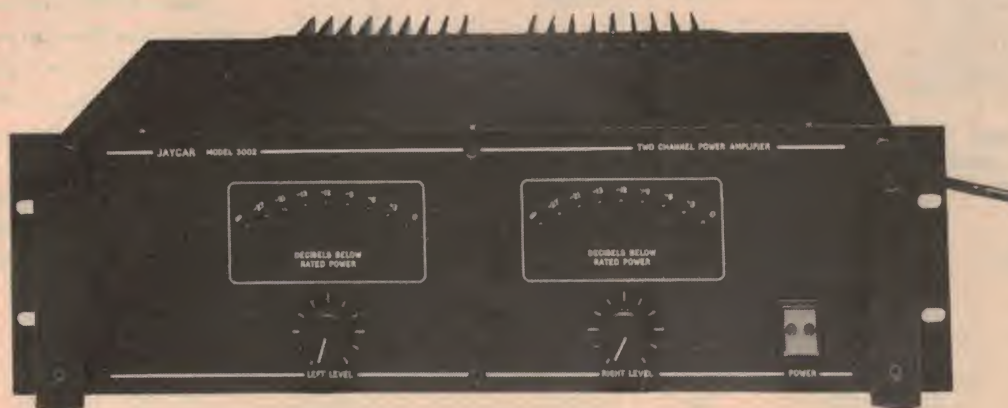
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**COMPLETE KIT  
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200 watts/channel into 4 ohms.  
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Hum and Noise — 105dB below rated output.  
Harmonic Distortion — Less than 0.05% to 80 watts.  
Less than 0.15% at rated power.  
Input Sensitivity — 1.0 volts for rated output.  
Dimensions — 482mm x 133mm x 340mm.  
Weight — 20 kgs.

### 3002P.A. 300 WATT POWER AMP MODULE



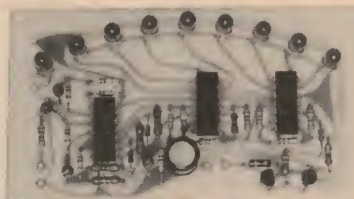
The same amplifier module as used in the complete amplifier. The 3002P.A. is based on the ETI 466 amplifier but with a redesigned P.C. board and much improved heatsink bracket. The module is designed to mount vertically in a 5 1/4" rack box. Complete kit includes P.C. board, all components and anodised heatsink bracket.

**COMPLETE KIT ONLY \$70.00 plus freight.**

Heatsink — Phillips 65D pre-drilled and tapped, and anodised black — \$32.50 plus freight.

Ferguson PF-4363 transformer \$38.00 plus freight.

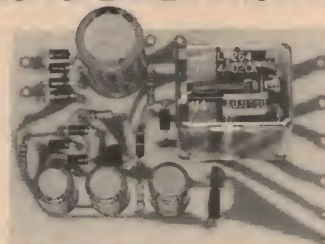
### 3002P.M. POWER LEVEL METER



The 3002P.M. can be used to indicate power output of any amplifier from 5 watts to 300 watts. Several component changes converts the module from a power meter to a VU meter.

**COMPLETE KIT ONLY \$18.00 per pair.**

### 3002SP SPEAKER PROTECTOR



The 3002SP can be connected to any amplifier output to provide a turn on delay to eliminate thumps and full protection against D.C. voltages on the output of the amplifier. One module will protect two channels.

**COMPLETE KIT ONLY \$13.00 each.**

**jaycar**  
PTY LTD

**380 SUSSEX STREET, SYDNEY, NSW**  
**P.O. BOX K39, HAYMARKET 2000**  
**TEL: (02) 211-5077**



## OCTOBER 1980

Complete information on using these predictions can be obtained by sending a stamped, self-addressed envelope to:-

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A map of New South Wales, Australia, divided into four regions by dashed lines. The regions are labeled: WEST COAST (WC) in the west, NORTH-EAST (NE) in the north-east, SOUTH-CENTRAL (SC) in the south-central, and EAST COAST (EC) in the east. Each region has a black dot indicating a location. The map is set against a light orange background.

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**East Coast to South Africa**  
(Also serves S.C.)

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### North East to South Africa

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### West Coast to South Africa



# A SUPERB DIRECT-DRIVE TURNTABLE . . . SANYO TP929

NOW AT A PRICE YOU CAN AFFORD . USUALLY \$279

**SPECIAL  
OFFER**

**NOW \$189**

(LIMITED STOCKS ONLY)

- Semi automatic
- 2 speed
- 120 pole synchronous motor
- 0.03 percent wow and flutter (WRMS)
- 1 second warm-up
- built-in stroboscope
- 1 kilogram platter
- cartridge included
- 2 years warranty



## **PHILIPS LOUDSPEAKERS**

### **PROFESSIONALLY DESIGNED SPEAKER KITS**

If you are in the market for a \$2000 set of speakers with only a few hundred dollars in your pocket, we could have just what you want. The ETI 4000 Series Speakers — using Philips Drivers — compare very favourably with speakers costing twice to three times as much. If you are on a really tight budget you could consider the Philips AD12K12 kit — a 70 watts r.m.s. per channel 12" 3-way system — which you assemble completely in about 2 hours. A steal at under \$300 per pair. You can buy all components with or without boxes, any way you like. We have both the ETI 4000-I and II on display, as well as other Philips Kits. Come in for an audition, or write for further information.



**northpoint hi-fi**

**WAGNER ELECTRONICS**  
**SALES & SERVICE**

100 Miller St, North Sydney.  
Ph 922-7780.

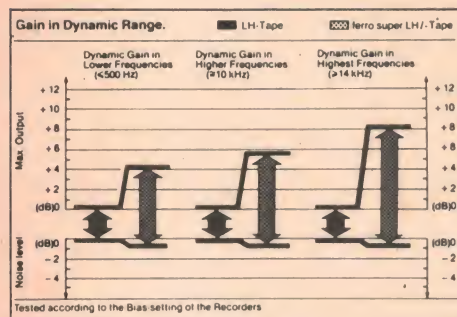
305 Liverpool Rd, Ashfield.  
Ph 798-9147.



# The new BASF high precision cassette.

## An unbeatable case for buying The Green One.

Dubbed The Green One for ease of identification, the new BASF ferro super LH I displays high precision and performance throughout.



In the mechanics of the cassette, BASF has achieved new standards of azimuth precision, taking full advantage of the outstanding LH I quality.

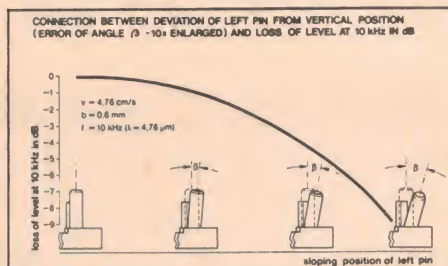
A dense coating of super-fine

ferric oxide particles has produced a mirror-finish tape with extremely strong magnetic direction preference.

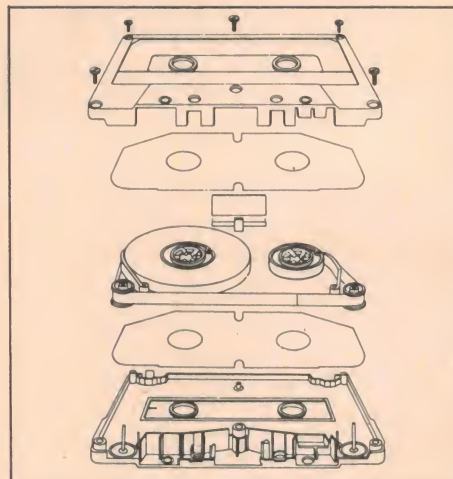
The end result—true Hi-Fi in the normal bias position I (Ironoxide or Fe 120  $\mu$ s EQ). Plus higher volume levels with minimised distortion.

One common cassette fault. Deviation in vertical position of the pins diminishes high-frequency output, which results in loss of sound brilliancy. Minimum tolerances ensure that no fault can occur with the new BASF ferro super LH I.

In the tough, screw-together polystyrene, precision moulded shell, slip sheets eliminate tape edge damage. A mu-metal shield blocks stray magnetic fields. A felt pressure pad on a phosphor



bronze spring ensures precise head contact on any deck. Flanged roller guides on lubricated stainless steel pins provide precise tape feed and azimuth alignment.



The patented BASF Security Mechanism (SM) prevents scrambling of tape and guides the tape smoothly within the cassette. A large strong window gives clear visibility to the best BASF ferro super I tape yet.

So spend a little more, and get more for your money.

**Go for The Green One.**  
**Step up to Hi-Fi precision.**



# BASF

**Quality across the range.**



FCB/SPASM/BAS/40R



# "I have always wanted a really good loudspeaker system."



Today the cost of excellent turntables, cartridges, tape decks and amplifiers has fallen to the point where the average family man can afford equipment of a quality and performance-level that was impossible ten years ago.

But good loudspeakers have remained extremely expensive and, in most domestic hi-fi systems, the rest of the equipment can dramatically outperform the speaker.

Philips have set out to correct this imbalance.

In co-operation with Philips Elcoma Division, a leading Electronics magazine has developed the ETI 4000/1 speaker system.

The ETI 4000/1 is available in kit form which means you save money by assembling it yourself.

A total kit, including:

- 8 loudspeaker drivers (4 per box)
  - 22 element crossover networks
  - pre-assembled boxes.
- For around \$798.00 per pair. (\$300.00 less, if you build your own boxes)!

The ETI 4000/1 is comparable to systems selling for twice the price.

See your Philips dealer today or send for complete details including a free reprint of the original construction article. Further information on Philips loudspeakers; a list of Philips dealers and a free 4-speed stroboscope card for checking the speed accuracy of your turntable.

#### Philips Electronic Components and Materials

P.O. Box 50  
LANE COVE, N.S.W. 2066

Please send me complete information on the ETI 4000/1 loudspeaker system plus my free 4-speed stroboscope card and further information on loudspeakers.

NAME  Please Print

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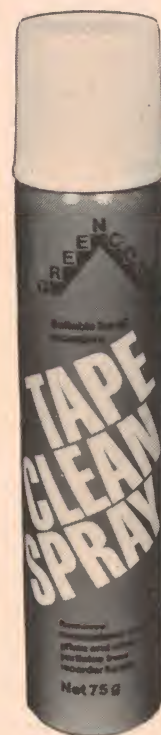


**Electronic  
Components  
and Materials**

# PHILIPS

AHEARN EL 30





For orders over \$60.00 we will include a can of Tape Head Clean Spray valued at \$2.25.

## 114 — September 1980 ETI





# OSOUND

**FEATURE:** ● **RECORDING TAPE AND TAPE RECORDING** 124  
**REVIEWS:** ● **DBX 3BX DYNAMIC RANGE ENHANCER** 138  
● **CELEF MINI SPEAKERS** 144





A dream come true  
demands music  
as true as the dream  
- Nakamichi





For further information contact Convoy International Pty Ltd 4 Dowling Street Woolloomooloo NSW 2011  
Telephone (02) 358 2088



# For those who appreciate simple virtuosity

## The 480 Series

With the 480 Series, Nakamichi again offers a more affordable cassette recorder – a deck that is simpler to operate, but that sacrifices neither Nakamichi sound nor Nakamichi excellence. The secret is simple. The Asymmetrical, Diffused-Resonance Transport – shared by all models and closely akin to that of the highly acclaimed 582 – is a 3-motor, dual-capstan drive so unique in its simplicity and elegance that it can be manufactured with virtually zero defects. Each 480 Series deck is factory calibrated to yield optimum performance with three types of tape – ferric, chrome-equivalent and metal. Use products of equivalent quality, and you can experience Nakamichi sound and Nakamichi specifications – response to 20 kHz – in *your* home.



### 480

The 2-Head Model 480 – fully metal-compatible thanks to our special, narrow-gap, Sendust R/P head and exclusive Direct-Flux erase head. Wide-range, peak responding meters, professional sliding record-level controls, Dolby, and defeatable MPX filter, of course! Even an optional remote control.



### 482

Step up to the 482, a 3-Head deck utilizing Nakamichi's exclusive "Crystalloy" cores and "Discrete-Head" technology. For those who demand "off-tape monitoring", the 482 incorporates two complete sets of electronics and Double-Dolby so you can hear exactly what *has* been recorded as it is being recorded.





## Minimise infidelity — keep your body in good shape!

BASF have paid as much attention to the body of their latest audio cassette as they have to the tape itself.

**This is important because distortion of the case, poor location of the pins and shafts, wobbly guide rollers and slack pressure pads can all prevent the tape from passing the record and replay heads at the correct height and angle.**

Even a small variation in azimuth (the angle between the direction of tape travel and the direction of alignment of the head) can cause a noticeable degradation of the replay response, especially at high frequencies. For example, an error of only 12 minutes of arc will cause the output to be down 3 dB at 10 kHz.

It's also very important that the tape head height is right — that is, the recorded track on the tape should not overlap the head gap which is reading it.

BASF's new Ferro Super LH 1 is a normal bias 1 and 120 us equalisation tape contained in a precision moulded, high impact, thermally stable plastic case, the two halves of which are screwed together, not welded or pinned.

The quality of the housing means (according to BASF) that the pins will not 'dip' and introduce azimuth distortion. BASF say tests of the cassette on every type of cassette have shown a distinct reduction in wow, flutter and intensity variations.

The tape coating contains a finely particled "maghemite" variety of iron oxide which gives a noise figure up to 2 dB lower than standard LH tapes. A new production process allows a higher density of oxide particles than before and a much better alignment of the particles in the magnetic preferred direction.

The surface is said to be particularly smooth and slippery (which is kind to heads), abrasion-proof and mechanically strong.

So confident are BASF that the construction of the Ferro Super LH 1 cassette is reliable that they guarantee to replace one without question if it should ever fail for any reason.

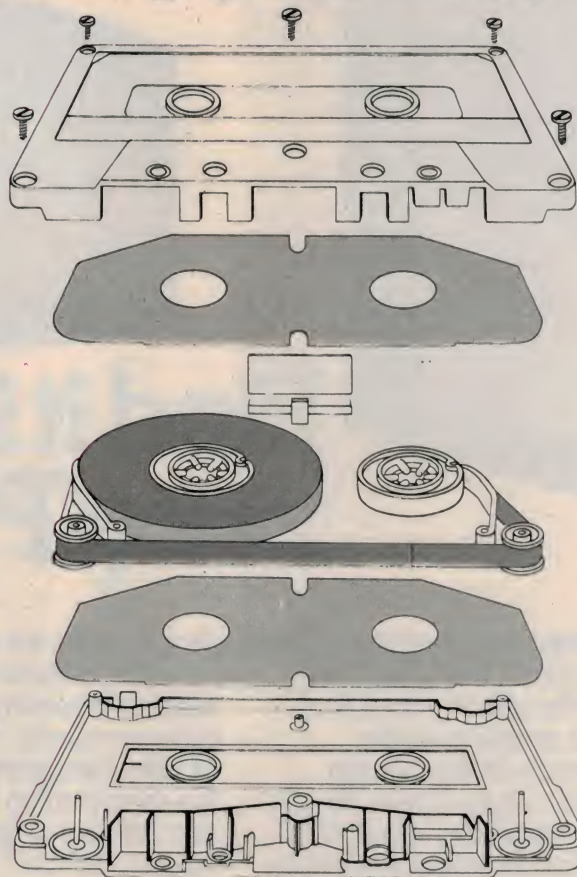
More details from BASF Australia Ltd, 55 Flemington Road, North Melbourne, Vic 3051. (03) 329-9555.

## Double launch by Mission

**Two new compact two way loudspeaker systems have recently been introduced by UK manufacturer Mission.**

Both are ported designs standing about half a metre high and both accept an amplifier signal power range of 15 to 80 watts per channel.

The 710 MK II speakers have a 210 mm polypropylene woofer and a 25 mm ferrofluid tweeter, while the less expensive 700 models have a paper cone woofer and a smaller (19 mm) soft dome tweeter.



## Phono matching aids

**Berkshire Audio have brought out a handheld capacitance meter to simplify matching phono cartridges to preamps.**

Serious degradation of frequency and transient response can result from presenting the wrong reactance to a cartridge and to make things difficult, almost every model of cartridge prefers a different capacitance.

The model CCM is a pocket-sized battery-operated instrument that measures the total capacitance (including cable capacitance) between the cartridge and the preamp. Its range is from zero to 1000 pf (in) with an accuracy of 5% and it is claimed to be the only instrument of its kind that can measure the input capacitance of a

preamp without regard to input resistance.

From the same manufacturer comes the Match-Maker, a switchable adaptor that plugs into the preamp phono input and accepts the phono cables. Up to 18 different loading conditions can be selected — capacitance in 50 pf steps from 50 pf to 350 pf and resistance from 22k to 100k. The unit includes a filter to eliminate interference from extraneous RF sources.

More details on both these items can be obtained from the distributors, M. R. Acoustics, P.O. Box 165, Annerley, Brisbane, QLD 4103.



# Somewhere on this 3 hour cassette a brilliant goal was scored.



## Find it in seconds with Sony 'Picture Search'.

Sony Betamax C7 solves one of home video's more frustrating problems with 'Picture Search'. Now it's simple to locate programme material in the playback mode. Picture Search plays in forward or reverse at 11 times normal speed with all the action on the screen. That means 3 hours of recorded programme can be reviewed in just 16 minutes. Now you can find that last minute goal without playing extra time. But then, Picture Search is just part of the magic Betamax C7.

### A choice of viewing speeds.

From 3 x normal speed to single frame advance, or variable slow

motion, that's the viewing versatility of Betamax C7. Sony's superior U-loading system ensures optimum quality in every mode.

### 14 day, 4 programme timer.

Pre-set recording times for up to four different programmes on the same or different channels up to two weeks in advance. Betamax C7 also features a cordless infra-

red remote control unit which puts all major functions including 'Picture Search' in the palm of your hand.

### Sony leads in home video.

1 million Betamax recorders and 20 million tapes have already been sold. With Sony Betamax C7, you enjoy all the benefits of Sony research and leadership.

## Sony Betamax C7



# SONY

There are two different Betamax units available, the C7E and the C7EC. For areas which require channels 3/4/5/5A, please specify C7EC. Your television should also have a UHF tuner.



## Noiseless discs?

Specially encoded discs with very low noise and wide dynamic range are to arrive in Australia very soon.

**The discs are encoded by the dbx type 11 noise reduction system, which dbx claim gives up to 30 dB of noise reduction (compared to about 10 dB achieved by the Dolby process).**

This is said to completely suppress surface noises, turntable rumble and groove echo.

A special dbx decoder has to be used when playing the discs and there are two different styles of these. Model 21 is a straightforward disc and tape decoder which can only be used

to replay dbx encoded discs and tapes. It is expected to retail at a little under \$200.

Or you can go for one of the dbx noise reduction units which have been around for some time. As well as dbx decoding, these can also be used as dynamic range expanders and noise reducers for normal discs and tapes.

More information from Electro-Voice Australia Pty Ltd, 174 Taren Point Road, Taren Point, NSW 2229. (02) 525-8588.

## Freon-cooled amp heads new Sanyo series

**Sanyo's latest power amplifier doesn't use conventional heatsinks to cool the output transistors.**

Instead, the temperature is kept down by using a heat pipe — a closed tube of freon with one end in good thermal contact with the transistors, terminating in a set of radiating fins at the other end.

As the transistors' temperature rises the freon begins to evaporate and migrate away along the tube, cooling as it does — until it eventually condenses and runs back as a liquid again. In this way the transistors' temperature is maintained close to the boiling point of freon, because increasing the power dissipated increases the **amount** of freon evaporated, not its temperature.

This unusual method of heat dissipation is a feature of the Plus P55 stereo power amplifier, which is part of the Sanyo Plus series of receivers, tape decks, turntables and other items which has just been released. In all there are 13 units in the series.

Like all the Plus series

amplifiers the Plus P55 amp has a moving coil cartridge preamp stage built in. Power output is 100 watts RMS per channel and total harmonic distortion is specified as a respectable 0.009%. Phono input sensitivity is 97 dB with moving magnet cartridges and 70 dB with moving coil types according to Sanyo.

In the same series is the Plus D62 cassette deck, which is compatible with metal tapes and incorporates Sanyo's Automatic Music Select System. A "Super D" noise reduction system, which is a separate unit, is claimed to improve considerably on Dolby techniques and increase dynamic range by as much as 40 dB.

Other items of interest are a receiver which is said to have THD of 0.03% or less and FM sensitivity of 10.8 dBf and the Plus T55AM/FM tuner, which has quartz locked tuning, digital frequency readout and a twelve station memory.



## Fast setting cassette deck

**The Pioneer CT-F1250 cassette deck can be manually adjusted for correct bias, level and equalisation in about twenty seconds, the makers claim.**

That's with a bit of practice, but the technique doesn't sound too hard to master. First you load the cassette and put the deck into Record, then you set a mode switch to Bias.

This sends to the record head a 2 kHz signal superimposed on a bias frequency that you vary until two arrowhead indicators light up. Without stopping the tape you then change mode to Level and make a similar adjustment until indicators light

and finally you do the same thing in the EQ mode.

The CT-F1250 is a three head, two motor machine with quartz controlled direct drive and a tape transport mechanism that keeps wow and flutter down to 0.03% WRMS.

It retails for a little under \$700 but the same manual tuning facility is also available on the lower priced CT-F950, CT-F750 and CT-F650 decks. Only the CT-F1250 will accept metal tapes though.

## Base for Connoisseurs



**A small Brisbane company are making a base specially designed for the famous Connoisseur BD1 turntable kit.**

The unsophisticated BD1 has been appreciated for years for its high performance and the new base from Woodland Audio is claimed to make it sound even better.

Made from a new high density resin-bonded material with lead damping panels, this base is said to cut down on acoustic feedback, improve stereo image and separation and increase dynamic range. It looks good too.

It comes predrilled to suit most tone arms and has a recommended retail price of \$96. More details from Woodland Audio, P.O. Box 307, Rocklea, Brisbane, QLD 4110.



**THE INCREDIBLE STUDIO 1000**



*N.B. MARUNI microphones take some beating too!!!*

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SUPERLATIVE HEADPHONES AND MICROPHONES

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# CASSETTE and RECORD CARE by the PROFESSIONALS...



# NAGAOKA

Look for this display when you next need cassette or record care products. The items shown are the cream of cassette and record care accessories and are a must for everyone who cares about their equipment.



- (a) CEIL:  
A velvet type dry cleaner for records.
- (b) BRIT:  
A velvet type moist cleaner for records.
- (c) AUTO-1:  
Standard and deluxe tracking record cleaners — provides gentle cleaning action whilst playing records.
- (d) CD-1:  
Cassette head cleaner and demagnetiser, simply place in cassette player for easy one step cleaning and demagnetising.
- (e) HI-CLEAN:  
Fluid styles cleaner and brush.
- (f) SB-1:  
Stylus cleaning brush.
- (g) TC-1:  
Pressure pack tape head cleaning spray with extension for cleaning inaccessible areas.
- (h) HC-800:  
Tape head and pinch roller cleaning kit, includes cotton swabs for effective cleaning.

*Nagaoka products are distributed throughout Australia exclusively by Goldring Audio Industries.*



**GOLDRING®**



# Recording tape and tape recording

If you're a newcomer to the popular pastime of tape recording and reproduction, here's a complete rundown on the technicalities



ALL HI-FI reproduction is dependent on the storage of information and its retrieval when required. Information stored on a gramophone record is in the form of a modulated groove, and the signal waveform is visible under a microscope or a powerful magnifying glass.

With tape recording, however, the signal is stored by a magnetic oxide that carries an invisible, varying magnetic pattern. To record and recover the information a series of energy conversions is necessary: acoustic-to-electric, electric-

to-magnetic, and vice versa.

As with the disc system there are losses and technical inadequacies that have to be compensated for by equalisation. However, in tape recording, equalisation is not a single stage process with mirror image characteristics used on record and replay. Instead, it is a complex two-stage process applied partly when recording and partly on playback, to give an overall flat response. Before we discuss this in detail

## John Gardner

let us consider the nature of tape and of the recorded signal.

Recording tape consists of a thin, pliable base of plastic material, such as mylar or polyester. The base is coated with a magnetic oxide paste about four  $\mu\text{m}$  thick (one  $\mu\text{m}$  is one millionth of a metre), the constituents of which are the oxide itself, a binder, a solvent, and a lubricant.

During manufacture the oxide powder, which is in the form of minute needle-shaped particles (or magnetic domains), is given a type of 'grain'. That



is, the particles have a common orientation. For some computer and video systems the grain is vertical — perpendicular to the direction of tape travel — but for conventional sound recording the grain is horizontal (Figure 1).

Aligning the particles in this way allows a more concentrated coating to be applied than would random application. For a given type of oxide and a given tape width, the thickness of the coating determines the maximum output possible from the tape.

The most commonly used oxide is gamma ferric oxide ( $\text{Fe}_2\text{O}_3$ ) and, until about 1966, it was the only oxide regularly used in the manufacture of magnetic tape. Later developments were chromium dioxide ( $\text{CrO}_2$ ), ferri-chrome — a mixture of ferric and chrome coatings — and cobalt. More recently 'metal' tape formulations have appeared (see July 1979 ETI, p.159).

Early ferric tapes were noisy, had low sensitivity, and poor high frequency response. With improved manufacturing methods the tape was improved immensely and finer oxides, with more regular particle structure, were developed to give lower hiss, higher output levels, and better high frequency response.

Chromium dioxide enjoyed a popular vogue in cassette recording but, while it has a slightly superior high frequency performance at low speeds, it is more prone to distortion than ferric tapes and is now being superseded by ferri-chrome. For reel to reel recording at speeds above 95 mm/s there is no advantage to be gained from the use of tapes other than ferric oxide.

## Tape magnetisation

When tape is in a so-called demagnetised state the individual particles (domains), although physically aligned, have no common magnetic sense (Figure 2). The domains may be regarded as minute bar magnets, but when these are of random polarity, as with blank tape, the only output produced by the oxide is in the form of noise. To record a signal on the tape it is necessary to modify the distribution of polarity so that a magnetic analogy of the audio signal applied to the machine's input is written along the tape's length.

To store the input signal on tape it must be converted into a form that the tape will recognise and retain. This conversion is carried out by the tape head (Figure 3.), which is effectively a ring-shaped electromagnet. The audio signal, in the form of a varying voltage, is applied to the head winding.

Now, if a current flows through a piece of wire a magnetic field is created around the wire, and if the wire is

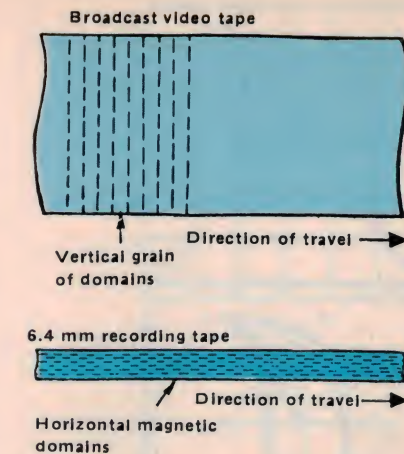


Figure 1. During manufacture the magnetic particles are given a common orientation.

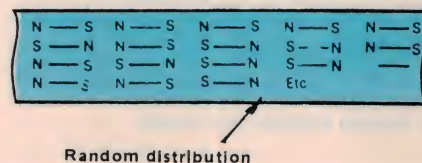


Figure 2. An erased so-called demagnetised tape with a random distribution of domains.

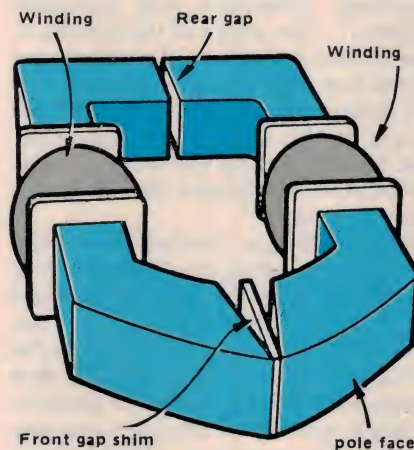


Figure 3. A typical record/replay head.

wound into a coil this field is intensified. If a core, such as soft iron, is inserted into the coil it will become magnetised and remain so until the voltage applied to the coil is removed. A tape head is simply a variation of this idea with the coil curved to bring the two ends (poles) into close proximity.

With a constant voltage applied to the coil, the iron core will have a North and South pole, rather like a horseshoe magnet. If the polarity of the supply voltage is reversed, the two poles will be reversed. If we substitute an audio signal, such as a sinewave, for the constant voltage, the poles will alternate in sympathy with the positive and negative half-cycles of the applied signal.

The strength of the poles at any instant will depend on the voltage of the signal, which in turn depends on the amplitude of the original sound. Because of a shim placed at the front of the head, filling the gap between the pole-pieces, the magnetic flux cannot easily pass from the North to the South pole. In fact, the reluctance of the shim (reluctance is the magnetic analogy of resistance) is so high that it is easier for the flux to complete the magnetic circuit by crossing the air space in front of the shim.

If a tape is passed over this concentrated magnetic flux the magnetic circuit is completed through the tape oxide. The effect of the varying flux on the moving tape is to produce a series of bar magnets along the length of the tape. The stronger the magnetising the greater will be the strength of the bar magnet so formed. The length of a particular magnet depends on the rate at which the applied magnetising force is changing polarity, and on the linear speed of the tape. (For example, at 10 kHz with a tape speed of 190 mm/s, the recorded wavelength takes up 0.019 mm of tape. Wavelength here is tape velocity divided by frequency.)

In the case of a sinewave input — as shown in Figure 4 — a wavelength consists of two bar magnets of equal length. The positive going half-cycle is represented by a North-to-South field, and the negative half-cycle by South-to-North field, although the opposite could equally well be the case.

So far the concept is relatively easy to grasp. An electrical signal is converted to a magnetic form and is effectively 'written' — in the form of a varying magnetic flux — on the tape oxide. It is then retained and at any time the message may be read by the reproducing system. What complicates the matter is that in both recording and

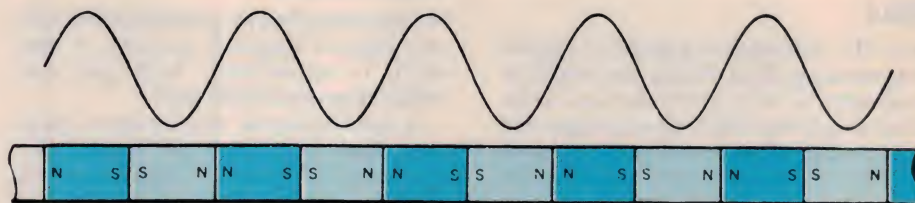


Figure 4. A recorded tape has areas of magnetic polarisation corresponding to the positive and negative half cycles of the applied waveform.



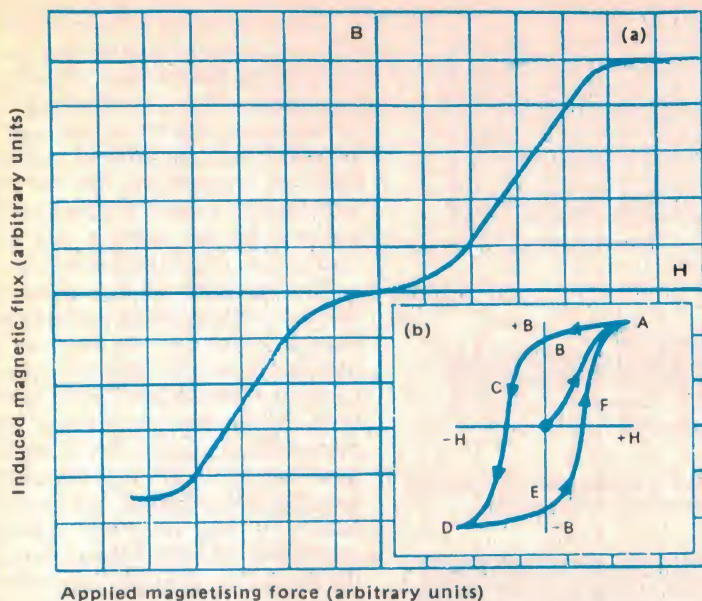


Figure 5. The non-linear tape transfer characteristic (a) is derived from the hysteresis loop (see inset). It is a graph of induced magnetic flux versus applied magnetising force.

replay the transfer from electrical to magnetic, and from magnetic to electrical energy is non-linear.

## Transfer

Every tape has what is known as a tape transfer characteristic, which shows the relationship between the applied magnetising force (H) and the resultant tape flux (B). This characteristic will differ from one type of tape coating to another — a typical transfer curve is shown in Figure 5.

The characteristic is derived from a hysteresis loop, which describes the tape flux resulting from the application of one cycle of magnetising force to the oxide. For the sake of simplicity we will ask you to accept the derivation of the hysteresis loop, and from it the tape transfer characteristic (TTC).

The significant thing is the shape of the TTC itself. There is a discontinuity at the origin of the B-H curve, with a nearly linear slope in the central region of the positive and negative sections of the curve. Beyond a given point an increase of applied magnetising force gives no increase in the resultant tape flux: this is the point of tape saturation.

## Bias

The TTC is therefore a graph of applied magnetising force versus the resultant magnetic flux induced in the tape oxide. If the input is in the form of a sinusoidal swing either side of the B axis (Figure 6) then the recording will be distorted because of the shape of the characteristic.

To overcome this distortion the input signal must be offset on to the linear

part of the TTC. This is done by superimposing the audio signal on a high frequency sinusoidal bias waveform (Figure 7). The shape of the bias envelope is thus a replica of the audio input signal, but this signal is now applied to the linear part of the TTC. One of the objects of bias adjustment is to ensure that the bias voltage gives the required offset of the audio signal on to the linear part of the curve.

Iron oxide and chrome tapes vary widely in their bias requirements — up to 40 per cent more bias being required for chrome tape, which is more consistent than iron and shows little variation between brands. Ferric tape varies considerably from one brand to another, and once a machine has been optimised for a particular brand of tape it is advisable to stick to that brand unless there are compelling technical or economic reasons for doing otherwise. When the recording bias is adjusted it will be found that if too low an offset voltage is used the signal will be distorted: if it is too high, demagnetisation of the high frequencies will occur and the top response will be impaired.

## Tape heads

In tape recording we are concerned with two types of magnetic material — that which is magnetically 'hard', and that which is magnetically 'soft'.

A hard material will retain a large proportion of any induced magnetism, which cannot be easily erased. Recording tape is magnetically hard.

A 'soft' material will react quickly to changes in magnetic force, but when

that force is removed will retain very little magnetism. This ability to react rapidly to changing magnetic conditions is exactly what is required of a tape head which, consequently, is made from soft material. In this context hardness and softness are magnetic, not physical properties.

Three functions have to be performed by the tape heads, functions that are so individual that, if they are to be performed efficiently, require three independent heads — erase, record, and playback.

For economic reasons manufacturers often combine the functions of two of the heads, and fit machines with an erase head and a dual purpose record/playback head. Apart from the engineering compromises that such an arrangement necessitates, there are also operational disadvantages, the most serious of which is that the tape cannot be monitored during recording.

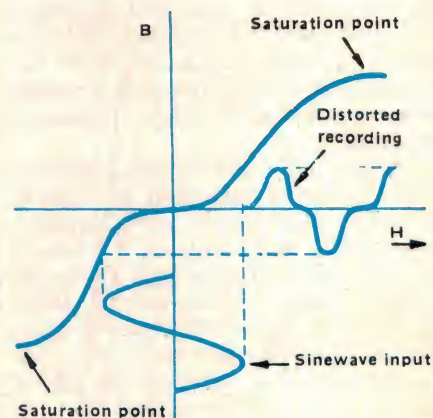


Figure 6. Distorted recording results from non-linear tape transfer characteristic.

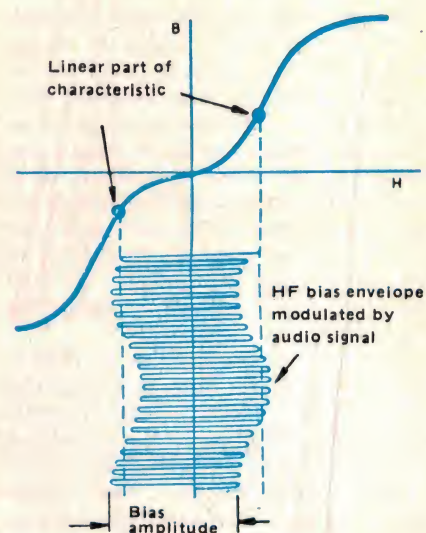


Figure 7. The distortion can be minimised by offsetting the audio signal onto a high frequency bias voltage.





The unique Allsop 3 cassette deck cleaner is housed in a cassette case

The Nagaoka cleaning tape, from Goldring, employs a special tape

## Tape Care Products

### Cassette cleaners

Users of cassette decks can choose from a wide variety of special cassettes that make head cleaning as simple as playing a tape. But make sure you buy a reputable brand — some cheap head cleaners are abrasive and may damage your heads.

**Bib's** cleaning cassette contains a non-abrasive textile ribbon and simply wipes off a fluid that is sprayed on prior to use. **TDK** make a cleaning cassette that runs dry and will remove light to moderate dirt accumulations from the heads, capstans and pinch roller. The Nagaoka Cleaning Tape 4, distributed by **Goldring**, has a specially treated polymer tape to clean the heads and two felt pads for wiping the capstan

and pinch roller.

**Philips** sell a kit that includes a cassette with a phial of cleaning fluid — you just put a drop or two of fluid on the textile tape before running it through your machine. For removing stubborn dirt deposits the kit also provides a few cotton buds.

**Ralmar** have a number of cleaning cassette outfits ranging from a simple cassette and fluid combination to their deluxe kit which also includes a cutter and splicer for tape editing.

Last but certainly not least is the Allsop 3, available through **Communications Power Inc.**, which contains an oscillating mechanism that rubs felt pads to and fro against all the parts that accumulate grime.

The basic elements of a tape head have already been shown in Figure 3. In the case of the erase and record heads the flux due to the current through the windings induces a varying magnetic flux into the core. In the case of the replay head, the magnetised tape induces a varying flux into the poles, which produce an electromotive force (emf) in the windings, and hence an electrical output.

Of particular importance are the width and alignment of the gap, and the shape of the pole-pieces in contact with the tape. The width and alignment of the gap largely determine the attainable high frequency response, whilst the head contact area affects the low frequency replay response. In order to maintain precise head alignment some manufacturers construct the head block as a single unit with the heads rigidly fixed to a common, machined baseplate.

### Erase head

It is a curious feature of the recording process that the bias waveform, which reduces distortion and enables a good recording to be made, also has the

characteristics required to erase the tape.

The important factor for erasure is a high enough current to carry the tape into saturation at each reversal of polarity. It is not possible to demagnetise the tape — the particles are always polarised in one direction or another. However, if the distribution of magnetism is completely random, the effect is of a mutual cancellation within the tape, which thus has no external flux.

The object of using a high frequency erase current is that it subjects the individual domains to a large number of reversals of polarity in a short space of time. The tape is moved through a concentrated magnetic field, the effect of which progressively reduces as the tape leaves the head. Therefore the tape is firstly repeatedly saturated at each reversal of polarity as it crosses the head gap. Then the weakening field, as the tape leaves the gap, is unable to reverse all the particles in a given area, and the final polarity a particle adopts is not greatly influenced by the original signal polarity. The tape therefore has a random magnetic distribution and is said to be demagnetised.

In practice it is possible for some of the particles to partially recover their original magnetic sense. For this reason a second pass over the erase head is often necessary to obtain complete erasure. To increase the depth of erasure many tape recorders are now fitted with double-gapped erase heads that give a similar effect to two passes of the tape across the head. The erase gap may be as much as 20  $\mu\text{m}$ , although with a double-gapped head the second gap is usually considerably smaller. The erase frequency must be high enough to produce the rapidly reversing flux and to avoid the generation of spurious beat frequencies (with 19 kHz and 38 kHz signals from stereo tuners). It is usually in the region of 80 to 150 kHz.

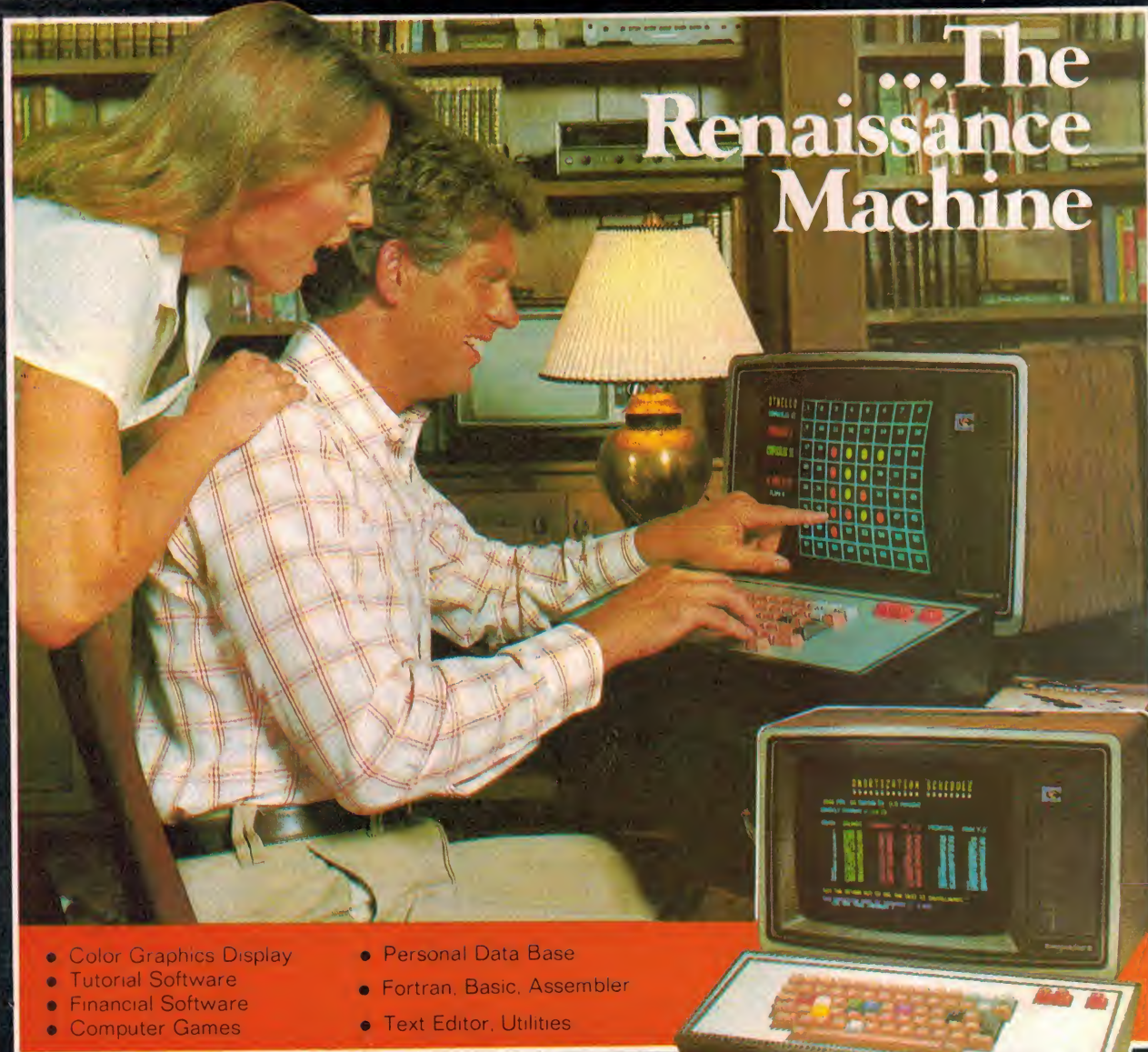
### Record head

Whereas at the erase head a saturating magnetic force is used to remove any existing signal waveform from the tape, at the record head a bias current of precisely controlled amplitude is mixed with the audio signal to minimise distortion of the audio waveform.

— to page 131 ►



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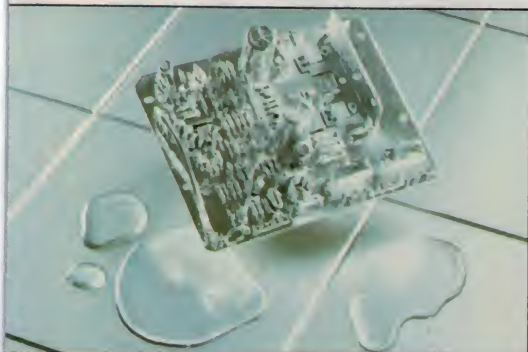


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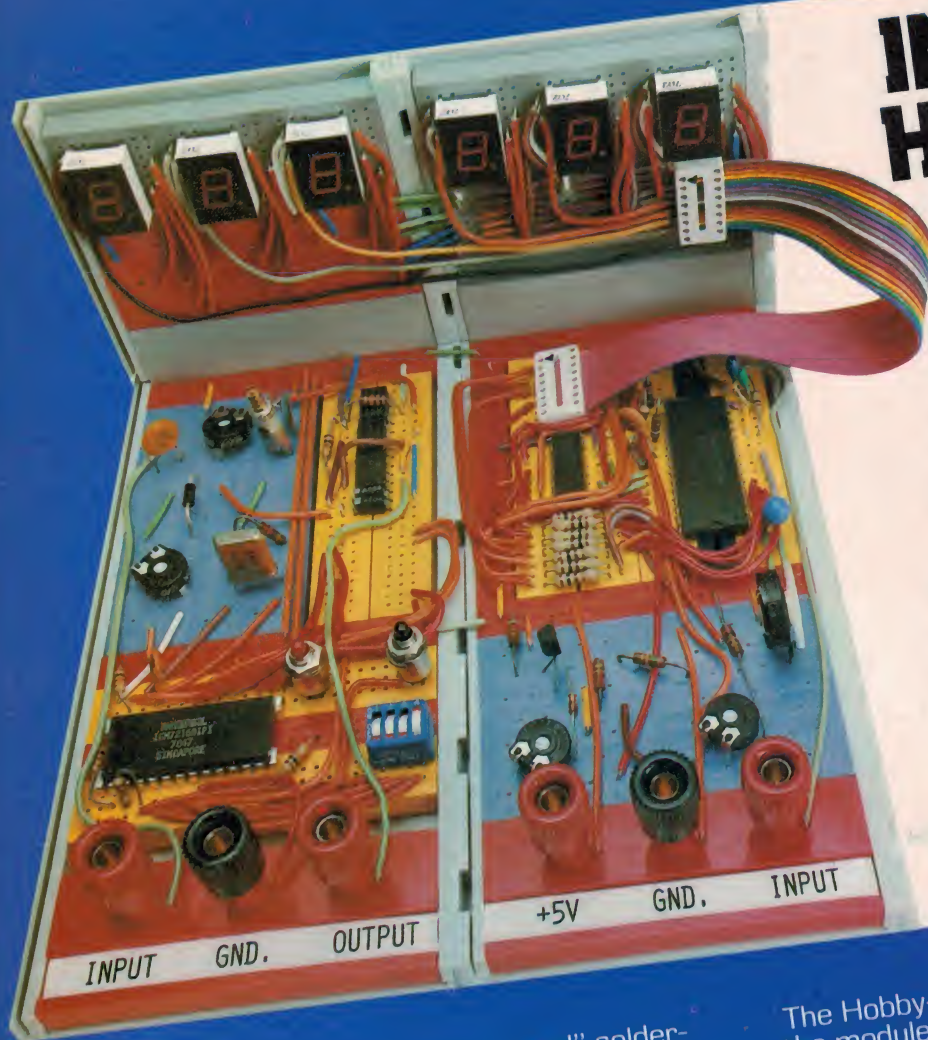
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Maxell's head cleaning kit is very comprehensive.



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## Tape Care Products

### Mind your heads!

NOTHING spoils the performance of a tape recorder so much as dirty heads. Even if you're not worried about high fidelity you *must* use something to clean the heads every so often, otherwise your tapes will sound *terrible*.

There's a variety of solvents and tools on the market, some of them simpler to use than others. At the most basic level you can use a cotton bud dipped in meths, but it's better to use a specially formulated cleaning fluid such as that made by **Bib**. Or you can spray the heads first with an aerosol solvent, then wipe them off. **Dindy** and **Ralmar** both sell suitable spray cleaners.

Two of the leading cassette makers sell complete head

cleaning kits that can be used for both cassette and reel to reel machines. **TDK's** kit has a fluid that you spray onto the end of a cleaning probe. When the probe gets too dirty, you just snip off the end and extend the wick. The kit also includes a little mirror so you can check the heads really are clean.

**Maxell's** kit comes in a neat plastic box and includes fluid, mirror, straight and angled probes with discardable felt pads and a brush. **Bib**, who specialise in tape and record care products also do a kit of this kind, as do **Tandy**.

Remember, when you clean your heads, not to forget the capstan and pinch roller too. Dirt on these will soon be transferred to the heads and you'll be back where you started.

The record head gap is much smaller than the erase head. It must be small enough to produce a high flux density, but wide enough to allow for a number of changes of polarity of the bias waveform. Depending on the bias frequency, tape speed, and gap dimension, each domain is subjected to around 10 cycles of bias current. Again, the bias results in a polarisation of the magnetic domains but, because of the presence of the audio signal, as the bias field diminishes, so the polarity of the domains is increasingly influenced by this varying signal.

Thus, instead of the tape reverting to a natural state it is magnetised according to the amplitude and frequency of the applied audio signal. This means that the tape is recorded as it is leaving the head gap, and the gap itself is not too critical as far as the audio waveform is concerned. A typical record head gap for a machine running at 95 and 190 mm/s would be six  $\mu\text{m}$ .

The relationship between the current in the head winding, the permeability of the core, and the flux concentration at the gap is not linear. To overcome this a high reluctance rear gap is used that is analogous to a constant current resistor. The reluctance of the rear shim is so high in comparison with the rest of the magnetic circuit that it swamps any variation in the permeability of the core material, and a virtually linear flux is produced at the front gap. The rear gap is usually about 10 times that of the front.

### Replay head

A tape head is a piece of precision engineering. In the case of a replay head the tolerances are so closely defined that there is virtually no margin for error. Even a slight departure from specification can lead to a major loss of performance.

One of the most crucial dimensions is

that of the replay head gap. Due to the nature of the head material, the flux coupling with the poles, and the head-to-tape contact area, the effective gap may be as much as twice the physical gap. Because the replay head tolerances are so tight, if a dual purpose head is constructed it will, to all intents and purposes, be a replay head.

The output from the replay head depends on the efficient coupling of the surface induction on the tape with the head and its associated preamplifier. A replay head core has extremely high permeability — several thousand times that of air — so that the tape flux at the point of intimate contact with the head will seek the easy path through the head core.

The changing flux pattern as the tape moves across the scanning head results in an emf in the head windings, a voltage that increases with frequency because it is proportional to the rate of ▶



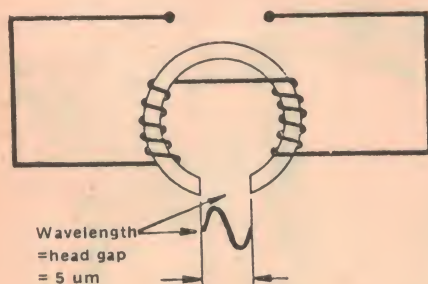


Figure 8. When the recorded wavelength equals the replay head gap there is no flux linkage with the head core and consequently no output.

change of flux. Hence, doubling the frequency will double the output from the head — in other words the output from an ideal head would rise at 6 dB per octave.

In practice a straight line graph is not realised, and the 6 dB per octave slope is only achieved at low and mid frequencies. At the upper end of the audio spectrum a point is reached (Figure 8) where the recorded wavelength is comparable with the effective gap of the replay head. When this point is reached the variation of flux will occur within the gap dimension and consequently there will be no output from the head. The frequency at which this happens is known as the extinction frequency, although the ideal slope does not suddenly fail as the extinction frequency is reached. As shown in Figure 9, it begins to roll off at about half the extinction frequency.

Now we can see the problem in perspective. To achieve a theoretical extinction frequency of 20 kHz at 190 mm/s the effective gap should be 9.5  $\mu\text{m}$ , giving a physical gap of about 5  $\mu\text{m}$ . The response of the head may not be as good as the theoretical figures given above, but in general the head with the narrower replay gap will have the better high frequency response.

## Replay system

We have briefly discussed the principles of the recording and replay processes. Let us now consider how the replay and recording chains are interlinked and equalised so that a flat overall response can be obtained.

We have already referred to the extinction effect, which is a major cause of high frequency loss. In addition to this, when the recorded wavelength is very short the individual poles are in such close proximity that some of the flux fails to emerge from the surface of the tape. Instead, it completes the magnetic circuit through the oxide and so does not

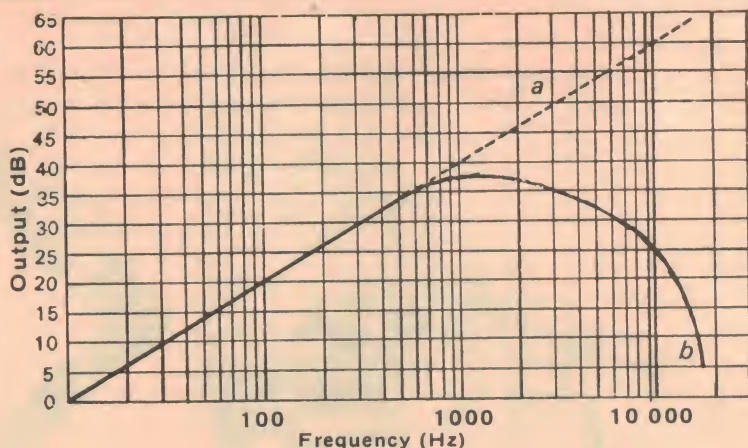


Figure 9. Replay head responses — (a) ideal response and (b) practical response with head losses.

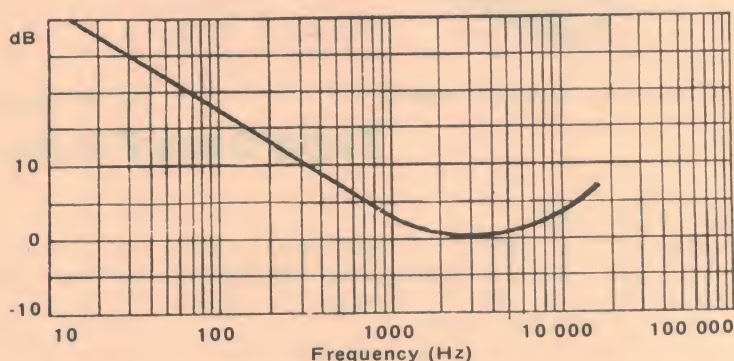


Figure 10. Theoretical response of the replay amplifier.

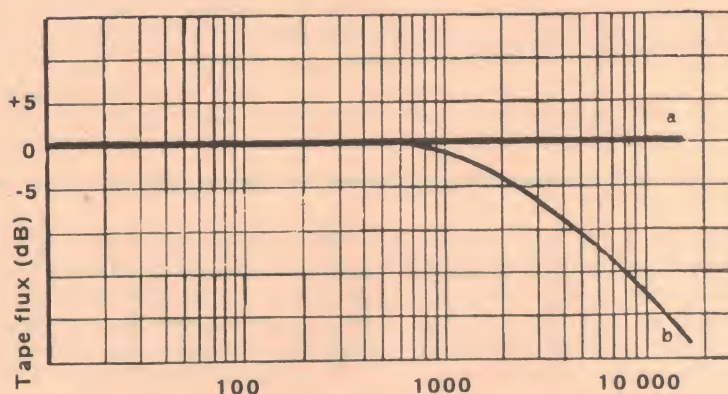


Figure 11. Ideal recorded tape flux (a) and typical tape flux allowing for head and other losses (b).

energise the tape head. Other losses are due to imperfect head-to-tape contact, and coupling losses between the head and preamp. At the bass end, where the wavelength is long compared with the head gap, the output may fall at a rate greater than 6 dB per octave as part of the flux path is through the air.

To compensate for the response at the head it is apparent that the replay amplifier must have an initial slope falling at 6 dB per octave, it must flatten out in the mid frequency range and then add a

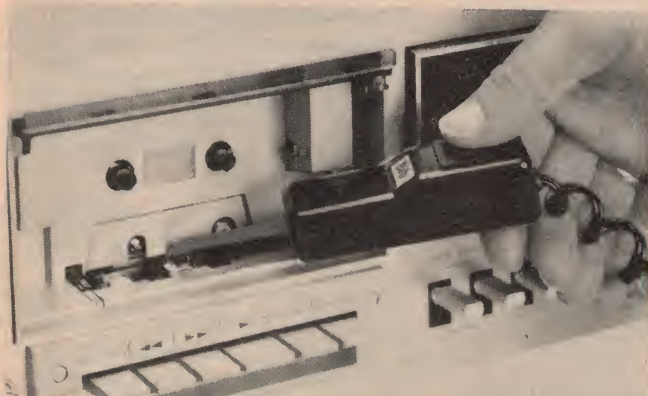
degree of boost at the top end to compensate for the head losses. Figure 10 shows the theoretical response of the replay amp.

## Record system

The signal current is fed through a resistor to the head winding and mixed with the bias waveform. The value of the resistor is such that it is well in excess of any change in impedance of the head (which increases with frequency). The effect is that variations of



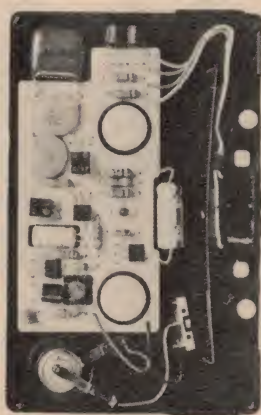
## Tape Care Products



The Bib demagnetising 'wand'.



TDK's cassette head demagnetiser comes in a cassette housing.



### Demagnetisation

To keep them responding as well as they were designed to, tape heads should be demagnetised regularly at intervals of not more than 40 hours use. Head magnetisation is an insidious process that invisibly degrades performance to a surprising extent. Noise levels on recording can rise in the low and mid frequencies by anything up to 7 dB and there can be a loss of playback quality with attenuation up to 1 dB.

Several companies make more or less sophisticated demagnetisers. **Dick Smith** have a mains powered unit for use on reel to reels and a combination cleaning and demagnetising tape for cassette recorders which uses a rotating magnet. **Ralmar** and **Philips** also make cassette cleaner/demagnetiser combos and **Dindy** sell the Ampex cleaner/demagnetiser as well as their own moderately priced mains demagnetiser.

**TDK** make a battery powered demagnetiser suitable for either reel to reel or cassette players. Its yoke angle can be varied for easy access to the heads and there is no need to withdraw it slowly from the heads because the circuitry produces a decaying alternating magnetic field.

The simplest of all demagnetisers to use are battery powered units completely enclosed in a cassette body. Both **Tandy** and **TDK** make these.

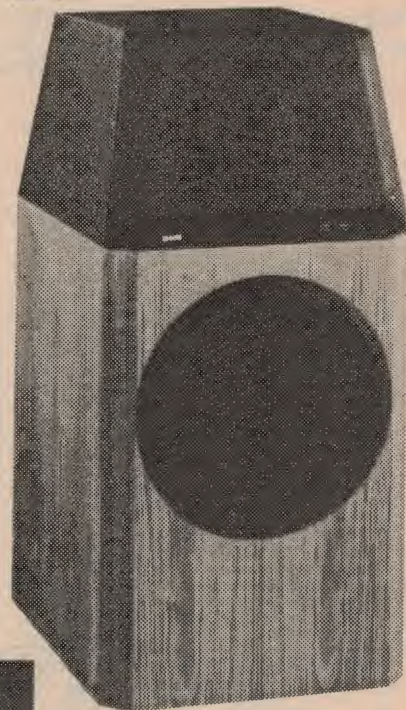
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SERIES 801  
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With the B & W 801, the design brief was brief. In fact, the required performance was summarised in just four telling words; full professional monitor requirements.

To qualify as a monitor by B & W standards, a system must have linear free-field amplitude response from 30Hz to 20kHz, with minimal deviation horizontally and vertically. It must be free from distortion and colouration and have an audio-powered overload circuit to protect against accidental damage or overload.

This is the Series 80 concept in a nutshell.



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head impedance are minor in comparison with the value of the feed resistor, resulting in a constant current input to the head. Thus, for a signal of given amplitude, the head current is constant regardless of frequency.

In theory this would appear to give a constant level of magnetic induction on the tape oxide. Again the ideal is not realised because of high frequency losses (Figure 11). In the main these are due to partial erasure of the signal by the bias, the falling permeability of the tape with increasing frequency, and poor head-to-tape contact. To compensate for these losses the theoretical response of the record amplifier should be the inverse of Figure 11. In fact it is not quite this simple.

If sufficient pre-emphasis were applied during recording to give constant tape flux with frequency, the tape would saturate at high frequencies. Also, as we have seen, the response of the replay head is not flat, and the response curve of Figure 10 would not produce a flat output from a tape flux that held constant with frequency.

## Equalisation

What is required is a two-part compensation process, part of which is applied on recording and part on replay. The

result should be a flat response over a given frequency range. However, because the losses vary not only with frequency but also with tape speed, the equalisation must be switched to give the optimum response curve for each tape speed.

Anyone with a turntable expects to be able to replay any gramophone record and to achieve a consistent standard of reproduction. Similarly it should be possible to replay a tape recorded on one machine on any other machine. Without this requirement each designer could equalise for the various losses in any way and, provided the machine had an overall flat response, the customer would be happy — until attempting to replay someone else's tape on that machine!

Obviously a standard is required, but to what does it refer?

It describes the recording characteristic, which is a curve of recorded tape flux level against frequency, and when plotted appears as in Figure 12. Tape flux is measured in nanowebers per metre (nWb/m) of track width, and recording characteristics are commonly referred to in terms of the circuit time-constants that would produce an impedance curve of the same shape.

The problem is to arrive at a recorded

tape flux (not frequency response) as per Figure 12, having taken account of the various losses in the recording system. To do this the designer usually begins with the replay system, knowing that if a calibration tape can be replayed accurately, one of the variables is fixed — replay equalisation. A recording amplifier can thus be devised that will produce the tape flux levels shown in Figure 12. If the sums have been done correctly a flat overall (record-replay) response will result.

To summarise this rather complex process: there are losses during the various energy conversions in the record and replay chains. Equalisation circuits are used during record and replay, such that an overall flat response is obtained. Because the losses in the system vary with tape speed, a family of curves is required if a machine has more than one speed.

To ensure that tapes can be interchanged it is essential that a tape recorded on one machine shall be reproduced satisfactorily by another. For this reason specific recording characteristics have been adopted, and provided a machine conforms to the appropriate standard, compatibility will be achieved. ●

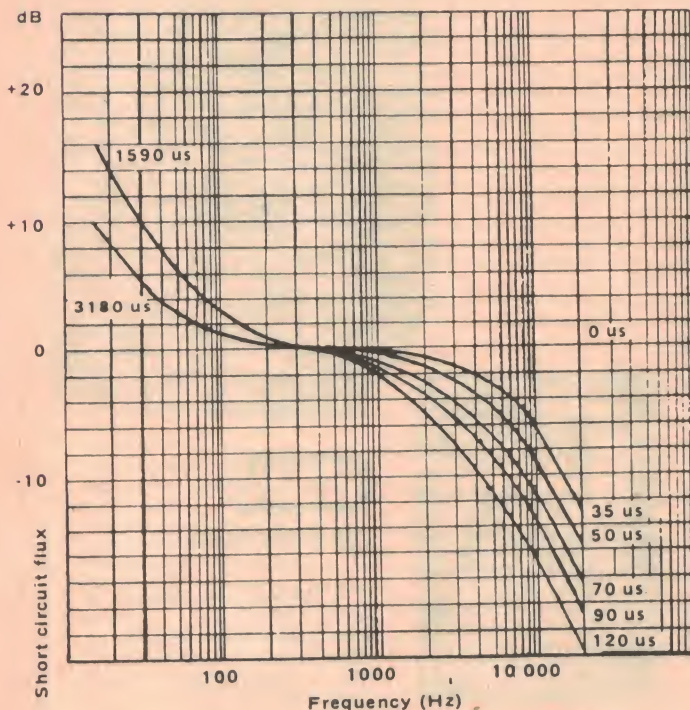


Figure 12. Recording characteristics to BS 1568: 1970.

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# Special Reader Offer:

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The Nagaoka Cleaning Tape 4 is a unique cassette head cleaner, designed to clean record/playback/erase heads, capstan and pinch rollers in one simple operation. Cleaning Tape 4 is particularly useful in cassette decks, particularly where the heads and rollers are inaccessible for cleaning (in car cassettes, for example). The size of Cleaning Tape 4 is compatible with all cassette units and is as easy to use as any cassette tape. Simply place in cassette unit and press the play button and in about 60 seconds all heads and rollers are cleaned.

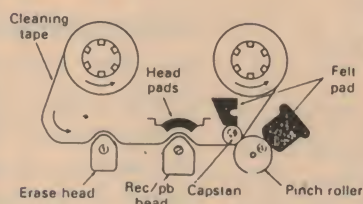
**NOTE:** This offer is made by Goldring Audio Industries and this publication is acting as a clearing house only. Payment should be made by cheque or money order, made out to 'Cleaning Tape Offer' and sent together with the order form or accompanying letter to **Cleaning Tape Offer, c/o ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.** We will then process your order and pass it on to Goldring who will send you the goods. Please allow at least four weeks for delivery.

### Features

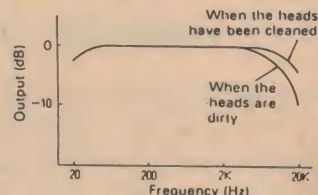
This special cassette can be used to clean the record/playback head, erase head, capstan and pinch roller of your cassette machine all at the same time.

It is ideal for cleaning car stereo cassettes which do not have easy accessibility and cannot be cleaned manually.

### How it works



### Changes in frequency response caused by dirt on the heads.



The cleaning tape is loaded face up and the cassette machine set to play or record mode from the rewind mode. Cleaning takes about one minute. If the tape is loaded reverse side up, the capstan and pinch roller will not be cleaned.

The action may be repeated if the machine is very dirty.

This cleaning tape cannot be used with dual capstan decks. If the felt pads become very dirty a Repair Pad kit (EX-209) is available to replace them. Cleaning Tape 4 is made by Nagaoka & Co Ltd, Tokyo, Japan.

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## DX5

**double coated Fe-Cr type music tape with improved high and middle frequency characteristics.**

**Fe-Cr position (EQ=70  $\mu$ s)**

The DX5 Series is a Fe-Cr type double coated tape, for music programs. Its well-balanced characteristics, which extend from low to high frequencies, have been realized by improving the qualities of the middle frequencies, while making full use of DENON's unique magnetic recording tape technology to achieve a reduction of distortion and a widening of the dynamic range. Particularly notable is the adoption of a method which employs an input signal similar to the music signal to measure dynamic distortion, which has been previously overlooked. Thus, as one would expect of a tape for music reproduction, the audible quality has been vastly improved.

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## DX3

**double coated tape for Normal position emphasizing music recording and playback.**

**Normal position (EQ=120  $\mu$ s)**

The DX3 Series is a Normal type double coated tape for music programs. Through the adoption of superior magnetic material and the application of experience accumulated in the manufacture of magnetic tape, the dynamic range and the distortion factor—extremely important elements in the recording of music—have been greatly improved. In addition to a reduction in conventional static distortion (third harmonic and intermodulation distortion), serious work has been done on the reduction of dynamic distortion, resulting in the creation of new standards for magnetic recording tapes.

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# DENON DX Series





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# The dbx 3BX three-band dynamic range enhancer

Louis Challis put it through its paces and found that "... results are outstanding, to say the least."

THE HOTTEST topic in the high fidelity industry at the moment is dynamic range, the difference in sound intensity between the loudest and the softest passages of a piece of music.

Sales of direct cut records, expanded range discs and dynamic range enhancers are not hard to find. The dynamic range of a typical orchestral concert in the Sydney Opera House is close to 90 decibels and a recording group in a well designed studio can span nearly 100 decibels.

By contrast, the dynamic range of a well cut conventional LP is less than 65 decibels, whilst a poorly cut LP or conventional pre-recorded cassette may not cover more than 45 to 55 decibels. Local FM broadcasts have a range of around 50 decibels, which is good but not outstanding.

Since most high fidelity systems are capable of reproducing a range lying somewhere between 65 and 85 decibels (and the best can cover 90 to 95), there is obviously a disparity between the records people have been buying and what their equipment can actually reproduce.

Firms like Sheffield Records realised this and released 'direct to disc' records with dynamic ranges of between 65 and 75 decibels. Telarc records, in the USA, achieve ranges approaching 80 decibels on discs such as Tchaikovsky's 1812 Overture (but the cannons will be brutal, perhaps fatal, to your amplifier, your speakers and especially your pickup cartridge).

However, the range of artists represented on such specialist record labels is inevitably limited. If your favourite performers are only recorded by standard techniques or if you simply want to improve the dynamic range of

your existing record collection, you'll be pleased to know that there is an alternative. It comes in the form of the dynamic range enhancer, of which the dbx 3BX is a particularly good example.

You may be wondering why nobody ever told you this before, but the chances are your local hi-fi outlet either could not get supplies or did not think you wanted to spend the money in any case.

## Compression and expansion

Before we describe how the 3BX works, we should look at the background more closely.

The idea of dynamic range alteration is far from new. The dbx corporation and others have been using this concept in the production of standard recordings for many years. Because most magnetic tapes cannot cope with the dynamic ranges that exist in the real world of music, recording companies have been forced to employ some kind of compression to make sure that the musical peaks aren't clipped or otherwise distorted and that the softest sections aren't drowned by noise.

Figure 1 illustrates *linear compression*, in which all levels of sound intensity above a certain threshold are reduced by the same fraction. The threshold is called the *transition level* and the amount by which the levels are decreased is the *compression ratio*. Sound levels below the transition level (0 dB in the diagram) are increased by the same ratio.

*Above threshold compression* is shown in Figure 2. Low level signals are unaffected but signals above the threshold are severely attenuated.

The reduction of dynamic range imposed by compression can be recovered by means of similar techniques which

boost instead of attenuate. Reasonably enough, a device which performs this function is called an *expander*.

The noise reduction circuits used in many tape recorders employ just these principles of compression during recording and expansion during playback. Figure 3 illustrates noise reduction with a linear compression ratio of 2:1 and a corresponding linear *expansion ratio* of 1:2.

The 3BX is the result of considerable research and development and incorporates several refinements of the expansion concept.

## Refinements

A simple linear expander looks at the level of the *total* audio signal and expands it all accordingly. In some cases, where the programme has a heavy bass line, this can cause audible 'breathing' as it raises high frequency noise when a loud bass note is detected. For this reason, the 3BX divides the audible spectrum into three bands — low frequency, medium and high — with each band being separately processed.

To optimise response time and prevent overemphasis of transients, the 3BX looks at the total energy content on a 'root-mean-squared' basis. Depending on the expansion ratio selected (which may lie anywhere between 1:1 and 1:1.5), the value of the transition level is set relative to an arbitrary mean. The transition level, which determines when the signal is amplified and when it is attenuated, is the most important factor affecting the characteristics of the sound, but two other parameters are also significant. These are the attack and release times.

*Attack time* is the time delay between the detection of an input signal level and its expansion. When the signal





level changes back to normal there is a delay before the expander changes its output — this delay is known as the *release time*. In general, attack and release times are independent of each

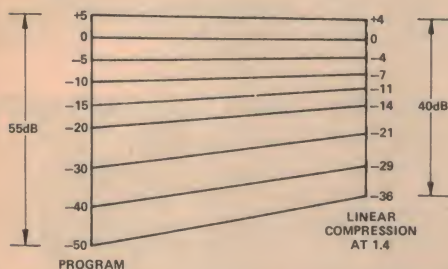


Figure 1. How linear compression reduces the dynamic range of programme material

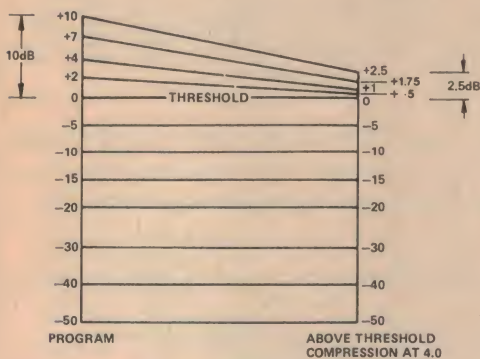


Figure 2. Above the threshold, compression has no effect on low level signals. When the signal exceeds the set threshold, the dynamic range is decreased. This is called 'above threshold compression' and allows higher compression ratios than linear compression.

other. The 3BX continuously varies each of them, in response to the overall sound 'envelope'.

### Layout and controls

The main unit is contained in an attractive black topped box with aluminium trim, wooden ends and photo-anodised front escutcheon which has obviously been designed for the American market. It features numerous controls, lots of flashing lights and plenty of pushbuttons. In addition there's a remote control unit that any knob twiddler will fall in love with.

On the left of the main unit are the power on/off and remote unit in/out pushbuttons, both with their own indicating LEDs, and a slider control for setting the expansion ratio between

1:1 and 1:1.5. In the centre are three rows of light emitting diodes for the high, medium and low frequency bands, with five yellow and five red LEDs in each row. The yellow LEDs cover the range from -20 dB to 0 dB and the red ones span 0 dB to +12 dB. The light emitting diodes thus form a 10 × 3 matrix which gives a graphical indication of what the 3BX is actually doing.

At the right is a slider control for varying the transition level and four pushbuttons for selecting source, tape and pre or post expansion when the unit is used with a tape recorder. At the rear are four sets of input and output circuits, which use coaxial sockets. There is also a 12 pin Jones type socket to accept the plug for the remote control unit.

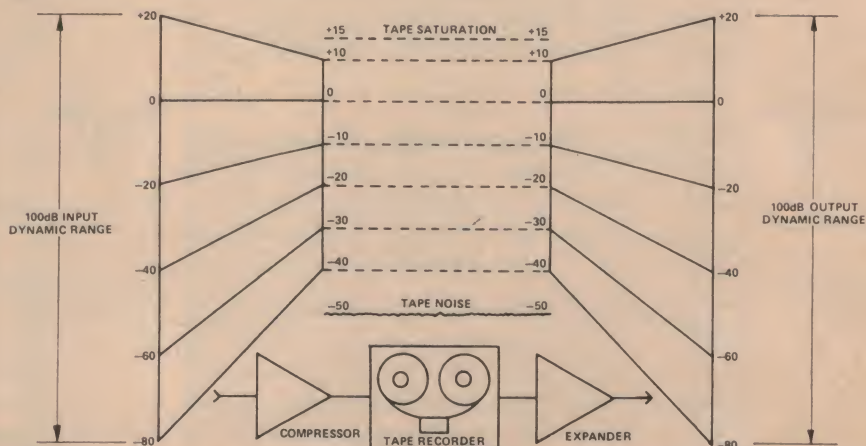
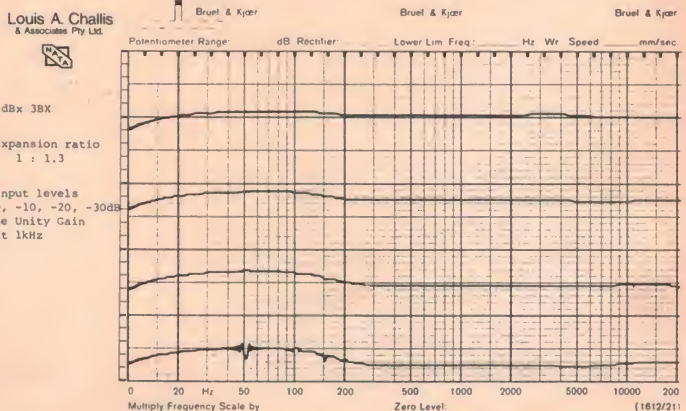
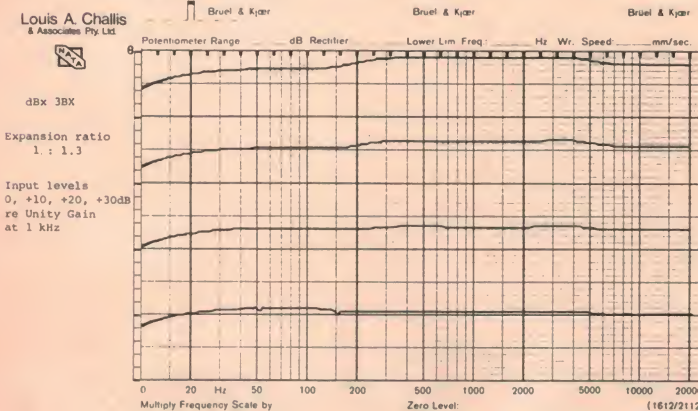
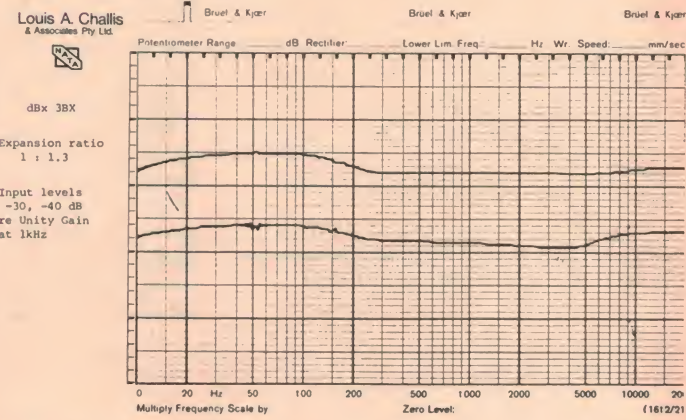
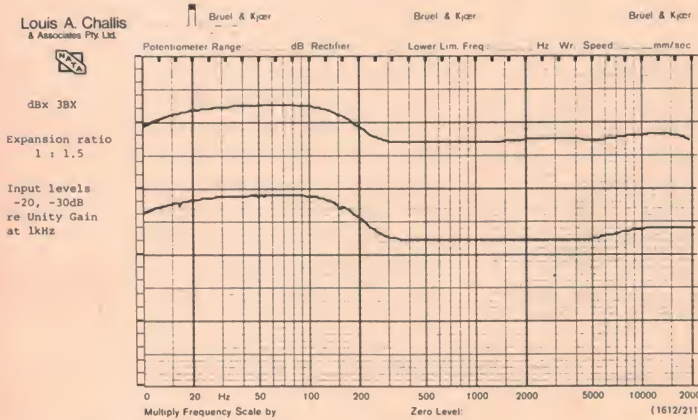
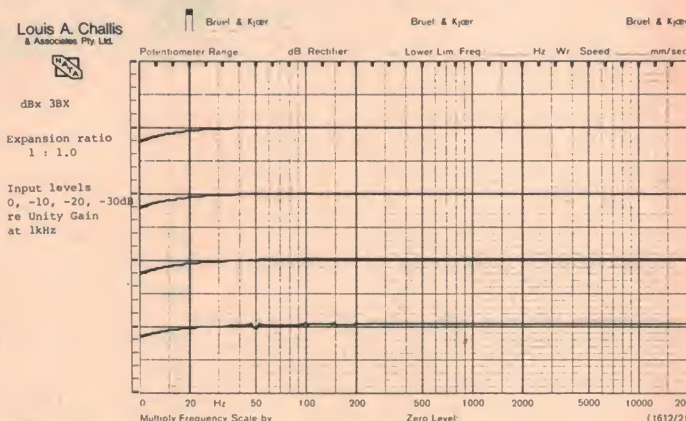
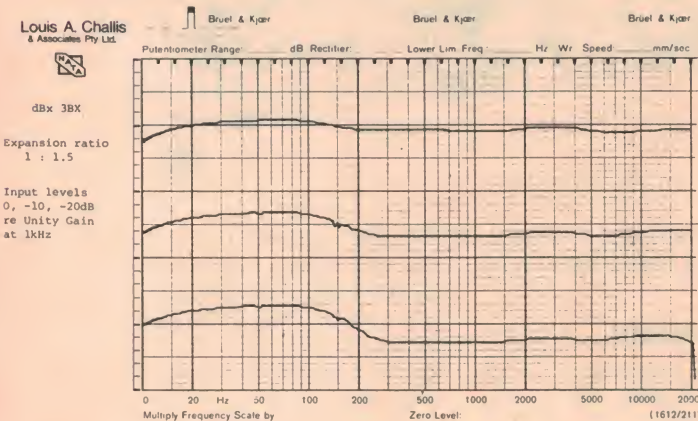
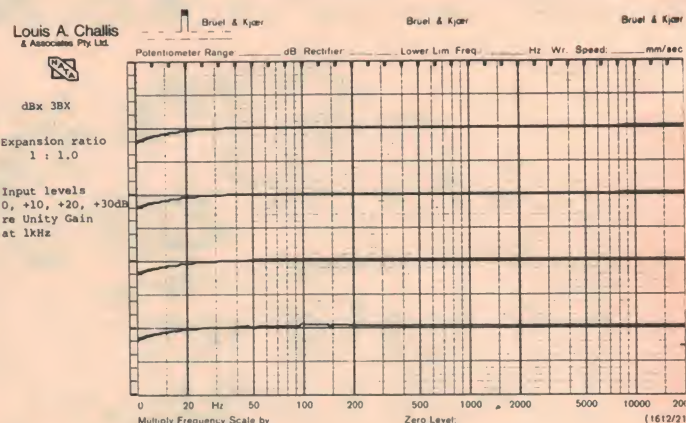
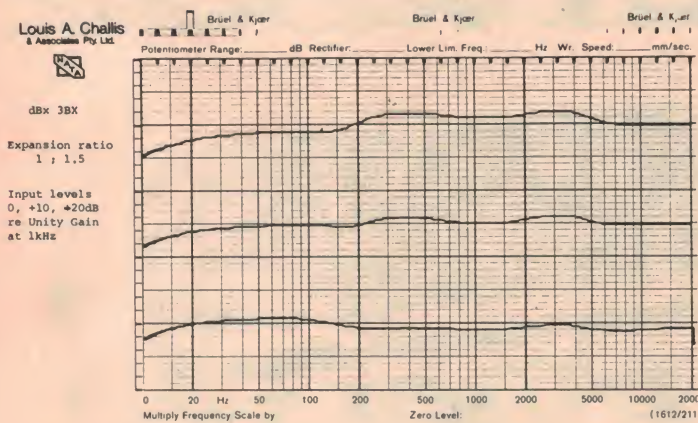


Figure 3. The dbx tape noise reduction system allows low level signals to be recorded well above the tape noise while recording peak signals below tape saturation. Expansion restores dynamic range.







The inside of the main unit contains one printed circuit. This is beautifully laid out, well labelled and more reminiscent of a computer card than a piece of consumer electronics. There are three slave boards for the light emitting diode matrix, a power supply transformer and a power supply module mounted on the rear panel.

## Remote control unit

Vaguely similar in appearance to the main unit but much smaller, the remote control unit features a sloped front panel (again with clear anodised lettering on a black background), four slider controls, two switches and a simple matrix of light emitting diodes — three yellow and three red. The yellow lights indicate decreasing gain, the red ones increasing gain and there is one pair for each of the three frequency bands.

As well as replicating the transition level and expansion ratio controls, the remote unit provides a number of additional functions not on the main unit. The first of these is an option to bypass from expansion to unity gain provided the remote control button has been activated on the main unit. Secondly there is a release time control which tailors the reaction time of the midband expansion to suit the type of music. This is normally set to fast for rock music and other types containing impulsive peaks and to slow for symphony music, with intermediate settings for other types.

Behind a panel at the rear are fade controls which allow the output to be slowly attenuated to any extent down to -46 dB over any period from 1 to 10 seconds. Fade-up time to normal can be adjusted from 1/4 to 4 seconds. These features are normally used for special effects, when making tape recordings

and particularly where the expansion ratio is in the 1:1 setting.

In the same recess is a high frequency transition control that adjusts the 'brightness' of the sound by altering the transition level of the high frequency band relative to the other two when the expansion ratio is set above 1:1.

These rear panel controls are adjusted by the individual user to suit his or her personal tastes, but the specific guidance given for these adjustments in the handbook is very poor and falls short of what either a professional or a serious amateur would call for. Finally, a slider control on the front face can be used to alter the total volume over a range from -20 dB to +6 dB.

## On test

The objective testing proved to be particularly interesting, for there really are not too many parameters that one can evaluate, apart from those nominated in the manufacturer's specification. These include expansion dynamic range, transition levels, frequency response, distortion and noise.

Not surprisingly, the electro-acoustic performance lives up to the maker's specifications extremely well. The frequency response at a 1:1 ratio is incredibly flat from 20 Hz to 20 kHz and is only 2 dB down at 10 Hz. This is true at virtually any input level over the 60 dB dynamic range which we selected for its evaluation. At an expansion ratio of 1:1.3 the frequency response was not quite as flat but still fully acceptable, showing peaks of +2 dB midband at +30 dB input level and +2 dB in the low frequency band at -30 dB input level.

Because of the manner in which the equipment is designed one can and should expect a slight nonlinearity in

frequency response, partly because of the availability of a preset trimmer for adjusting the relativity of the three bands and particularly as a result of the equipment's inherent feature of selectively expanding the low frequency, mid frequency and high frequency bands.

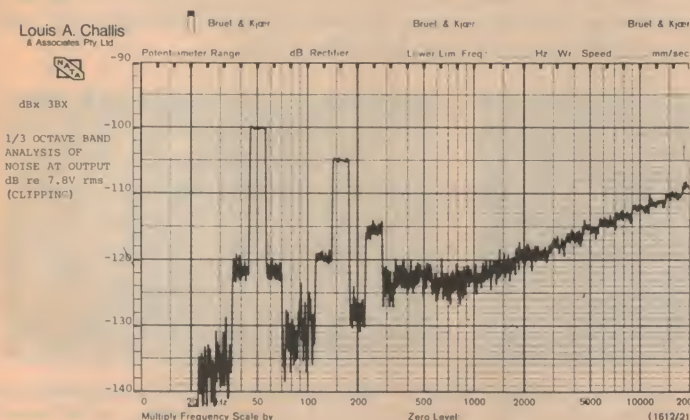
At an expansion ratio of 1:1.5 the non-linearity in frequency response becomes a little more pronounced and the unit provides a significant bass boost over the frequency region from 10 Hz to 250 Hz with input levels of -20 dB and -30 dB relative to the zero reference level. This does not necessarily detract from the performance of the unit, but as we subsequently found in the subjective testing it does change the timbre or quality of the sound.

The internal noise characteristics of the unit are impeccable and the A-weighted background noise level is -105 dB relative to the 7.8 volts clipping level, which guarantees a fairly spectacular dynamic range capability and virtual inaudibility of background levels under almost any operating conditions. It is interesting that the dominant internal noise frequency components are at 50 Hz, 150 Hz and 250 Hz and are produced by the internal power supply.

The equipment's distortion characteristics are equally impressive, being typically less than 0.13% at 7.8 volt output and even less at lower levels.

The square wave response, while not perfect in shape factor, is controlled to a large extent by the release time set on the remote control panel. Considering the dynamic characteristics of the equipment however, these responses are fully acceptable and generally indicative of a stable transient performance.

The tone burst test results show ▶



## dbx 3BX WITH 3BX-R REMOTE CONTROL 3 BAND DYNAMIC RANGE EXPANDER

### Other Tests:

THD: Square wave response no ringing  
Maximum Output level 7.8V rms  
Noise level see graph  
Attack and release times using tone burst generator.

THD	at 7.8V output	1:1.5 expansion.	
	100Hz	1kHz	6.3kHz
2	-67.6	-59.9	-67.2
3	-61.2	-62.0	-59.9
4	-83.7	-83.0	-82.7
5	-81.0	-84.4	-
THD	0.097%	0.129%	0.110%



clearly how the release time functions in both the fast and slow mode, and it is this parameter above all others which most directly affects the sound quality and the degree of naturalness which the 3BX achieves.

## Subjectively

I spent considerable time playing music at home with a wide range of programme content to evaluate the characteristics of the 3BX. It soon became apparent that there is no real benefit to be gained from playing direct cut records through the 3BX except at low expansion ratios.

But with older records, particularly where they are not scratched, the results are outstanding, to say the least. General surface noise is diminished and awareness of the subtleties of the original music is unquestionably enhanced.

Regrettably, I became aware of the extent to which I was listening to the equipment rather than the music. At expansion ratios of 1:1.4 and 1.5 this situation was exacerbated and on most of the programme content, especially prerecorded cassettes and older style records, this did detract a little from my listening pleasure.

At reasonable listening levels with a dynamic range in excess of 80 dB, one's choice of amplifier, and most certainly choice of speaker, becomes extremely important. Fortuitously, I chose to use a Sanyo DCX 8000K receiver with a 65 watts per channel capability. This could only just cope with the dynamic range of the system and highlighted the need for a power capability in the range 100 to 200 watts if one insists on using the expansion ratio of 1:1.5.

Equally significantly the faint background noise which this receiver would otherwise have produced was completely removed. On the silent grooves between individual record tracks I could detect no noise at all, even with my ears stuck up against the face of the speakers.

## Conclusions

The 3BX basically does everything the manufacturers claim. It can create from any record or tape an output which comes subjectively close to mirroring that from a direct cut disc. However, this cannot occur in the case of scratched records, really bad recordings or dirty records with clicks, pops and other disconcerting features.

The quality of sound that is created is

integrally bound up with the fade-up and fade-down rate control settings and with the choice of release times. Whilst I am sure that these can be optimally selected to achieve a greater degree of naturalness, I consider that without more explicit guidance from the makers this is unlikely to be attained in the short term and in some cases may never be achieved.

Nevertheless, for those of you who do not want to buy direct cut records the 3BX is unquestionably the most satisfactory way of achieving a comparable characteristic from your existing record collection. ●

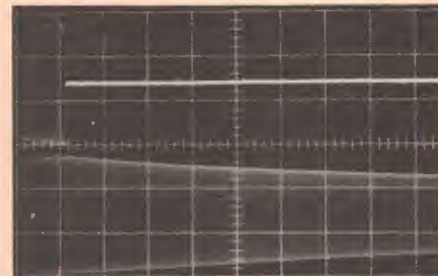
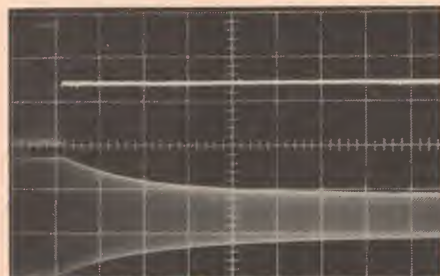
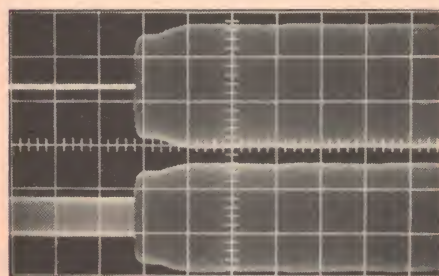
### THE dbx MODEL 3BX THREE-BAND DYNAMIC RANGE ENHANCER

Dimensions: (main unit) 450 × 95 × 255 mm  
weight: 3.19 kg  
(remote control) 235 × 98 × 152 mm  
weight: 1kg

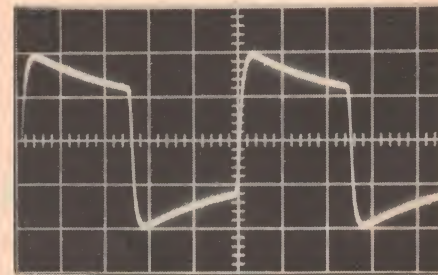
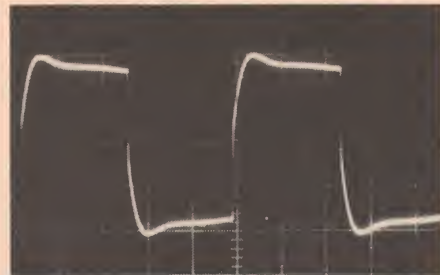
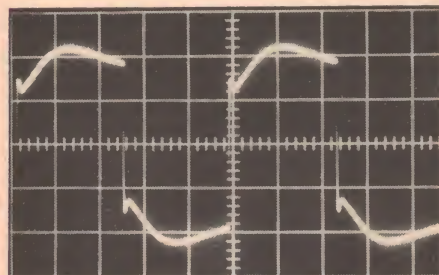
Price: \$1000 rrp

Manufactured by dbx Inc., Massachusetts, USA.

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Dynamic characteristics. Expansion ratio — 1 : 1.5; Channel 1 input — 1 kHz tone burst; Channel 1 output is upper trace in each picture; Channel 2 input — 1 kHz steady state sinewave; Channel 2 output is lower trace in each picture. Left picture shows attack time ('scope on 50 ms/div.). Centre picture shows FAST release time ('scope on 200 ms/div.). Right picture shows SLOW release time ('scope on 200 ms/div.).



Square wave response of the dbx 3BX dynamic range enhancer: Expansion ratio — 1 : 1.5; Release time — FAST. Left picture taken with oscilloscope set at 2 ms/div., 100 Hz input. Centre picture has scope set at 0.2 ms/div., 1 kHz input. Right picture taken with 'scope on 20 us/div., 10 kHz input.



# The weakest link in your hi-fi system isn't in your system.

You could spend thousands of dollars on your stereo system and still not hear its full musical potential. That's because all hi fi systems, even the most sophisticated, have one weak link — the music source itself.

Dynamic range (the difference between the loudest and quietest music passages) is one of the primary elements that creates the power and excitement of a live performance. Records (even digital and direct-to-disc), pre-recorded tapes and radio broadcasts sound lifeless in comparison because they're missing more than 1/3 of this

vital dynamic range. But add a dbx Dynamic Range Expander to any system, large or small, and the missing dynamics are amazingly restored.

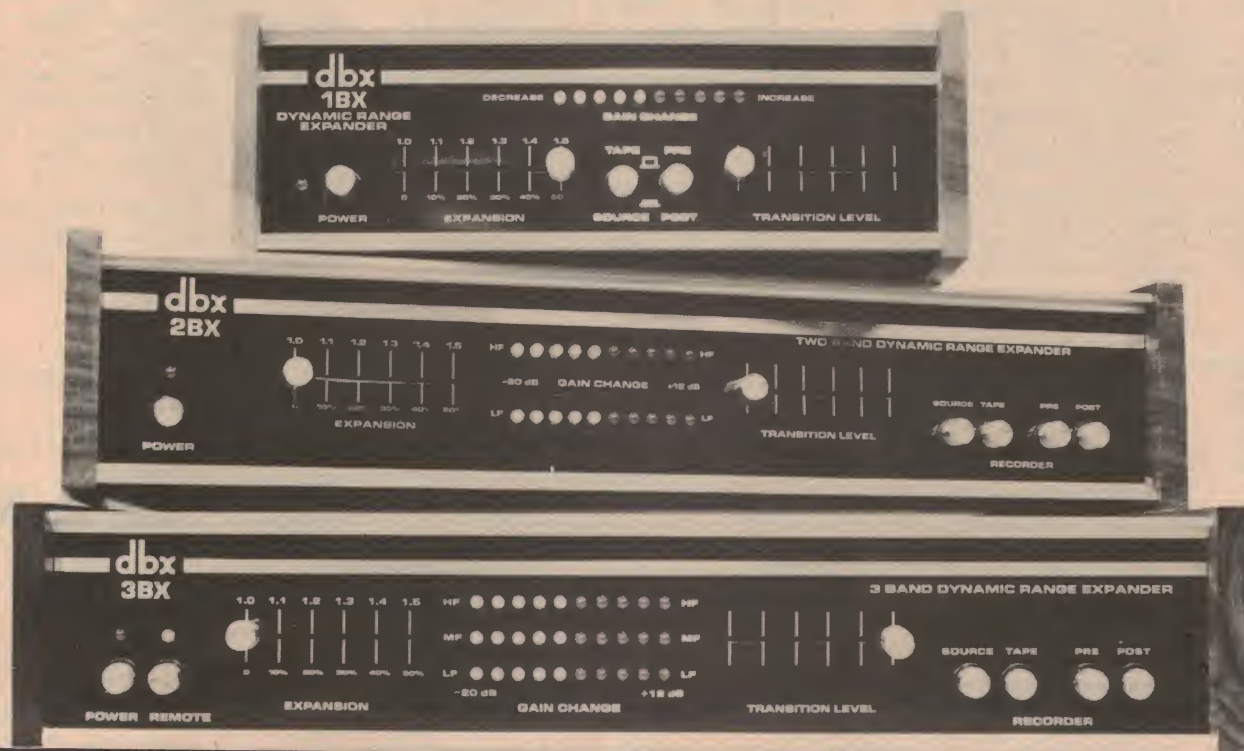
dbx offers three state-of-the-art expanders that let every stereo system flex its musical muscles. The 1BX, 2BX, 3BX Dynamic Range Expanders provide as much as a 50% improvement in dynamic range, with the additional benefit of up to 20dB reduction of background noise. Any model will let you

enjoy all the music you never heard from your record and tape library.

Don't let the weak link make your investment in a good stereo system worthless. Visit your nearest dbx dealer for a demonstration of the dbx dynamic range expander that best fits your budget. Experience all the emotional impact and realism that was missing from your music. Records, tapes and radio broadcasts never sounded so good.

**dbx**  
Making Good Sound Better

**the dbxpert,**  
174 TAREN POINT ROAD  
TAREN POINT NSW 2229  
(02) 525-8588





## Celef mini professional SM loudspeaker system

Handsome is as handsome does. These smart little speakers did well on the objective tests, less well subjectively.

IT'S OBVIOUS that considerable care has been taken to make these Celef Mini speakers look good and they certainly are attractive units. The enclosures are teak veneered on all sides and the dark brown cloth grille is sensibly fixed to a pineboard frame.

The speaker grille panel is kept in place by plastic captive ball retainers to preserve the neat appearance.

The speaker complement for the 50 litre enclosure consists of a 220 mm low frequency driver with foam surround and a 25 mm diameter Peerless dome tweeter. The woofer has an unusual plastic dress trim surround which takes care of the mechanical fixing of the speaker into the cabinet and provides full edge sealing as well. The magnet assembly is unsophisticated.

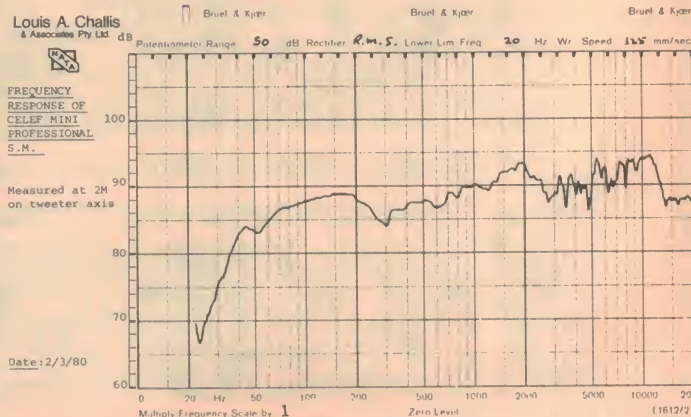
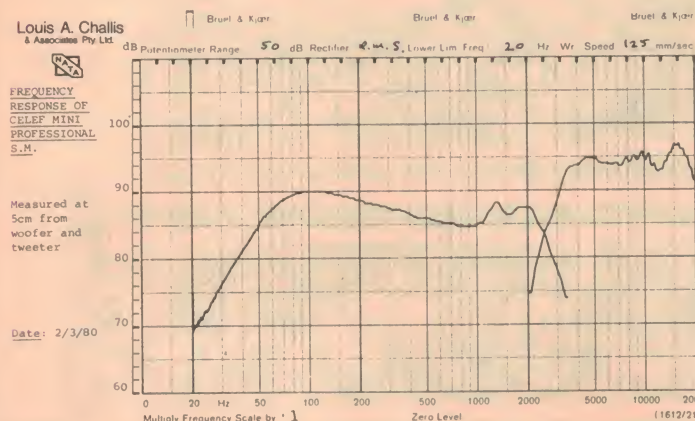
The 15 mm thick pineboard enclosure has been carefully damped internally by the application of a number of layers of bitumen felt stapled at strategic points to minimise resonance. Reticulated urethane foam on all the inner faces provides primary absorption and in addition a layer of bonded acetate forms a roll into which the crossover unit has been inserted. This may not be an original idea but it is nonetheless a very effective way of cutting costs.

The crossover itself features four inductors (three of them with ferrite cores), five capacitors and three resistors. Speaker leads are connected by means of two universal terminals recessed into the back of the cabinet and the units are specified as requiring stand mountings for best results.

### Lab. tests

Considering the size of the enclosure, the frequency response is reasonably good and in this respect the unit does not suffer from having only two drivers. On-axis response extends from 70 Hz to 20 kHz with a dominant tweeter output tending to lift the response in the 2 kHz to 13 kHz region. The low frequency response rolls off smoothly below 50 Hz.

The off-axis response is in general nearly as good, and the crossover frequency of 2.5 kHz has been well chosen to develop the best features of both the low frequency driver and the tweeter. Phase response of the unit is quite reasonable and particularly good from 200 Hz to 20 kHz. The impedance curve is unusual, dropping down to as low as







5.5 ohms at 18 kHz rising as high as 38 ohms at 1 kHz, but these excursions won't really trouble any modern transistorised amplifier.

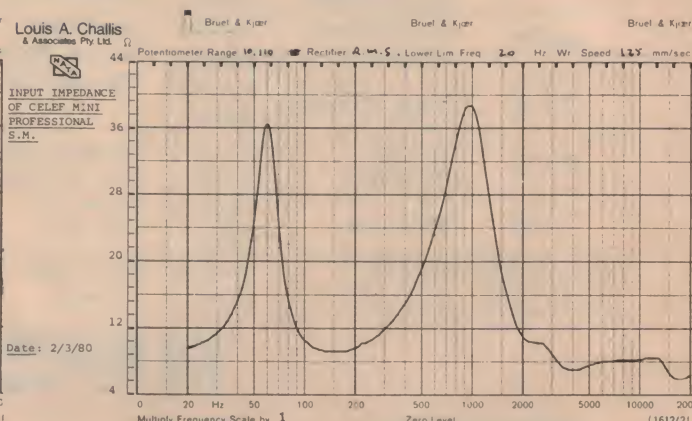
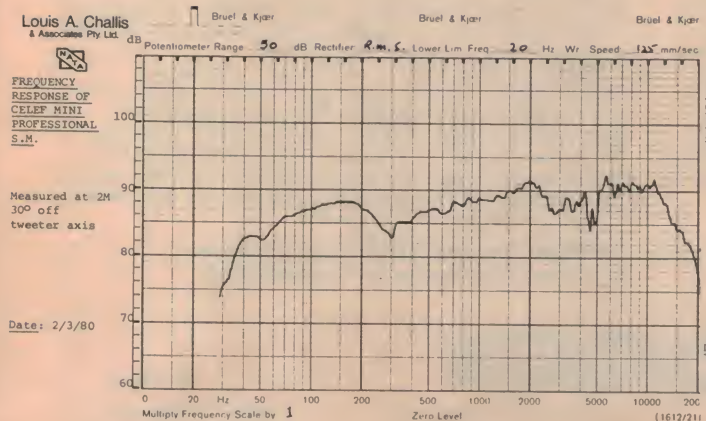
The total harmonic distortion characteristics of the speakers are fairly well controlled at outputs up to 90 dB at 2 metres, but at higher sound levels they rise dramatically for both high and low frequencies. Tone burst responses present a somewhat different picture — at 6.3 kHz and higher frequencies the amount of overshoot and instability did not augur well for the transient performance.

### Aural impressions

Our subjective assessment of the speakers proved to be less rewarding than we might have hoped. We made use of a number of our normal records and a few new ones to evaluate a number of specific characteristics.

On speech and singing, while the performance was relatively clean, there was nonetheless a distinct colouration which was especially pronounced at higher frequencies. Female voices were particularly affected. At levels above 95 dB at two metres there was a pronounced and audible distortion.

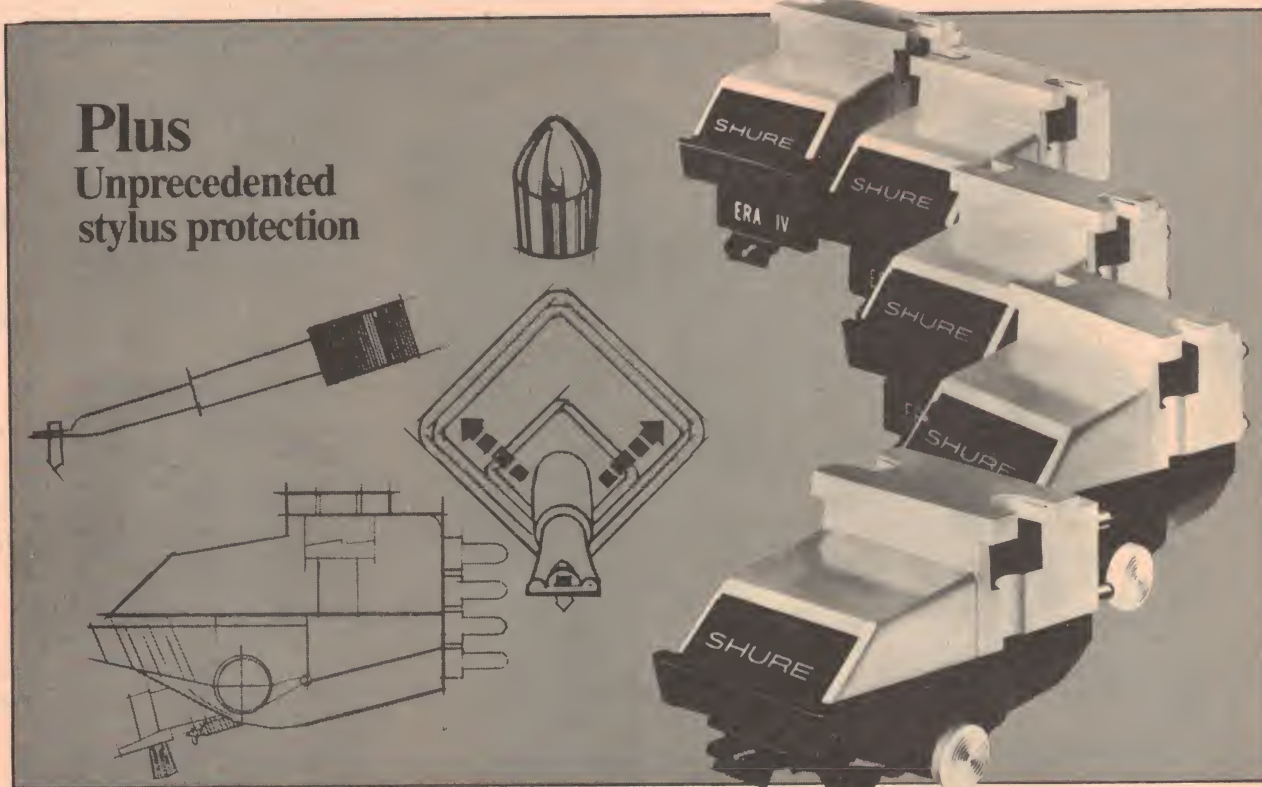
We tried out a new direct cut record from the Tokyo Quintet and found that the speakers had only a desultory response to the bass and tympany passages. A test with Led Zeppelin made it obvious that these speakers don't like rock either. On the other hand, violins and guitars were reproduced excellently.





# fact: five new Shure Cartridges feature the technological breakthroughs of the V15 Type IV

**Plus  
Unprecedented  
stylus protection**



## the M97 Era IV Series phono cartridges

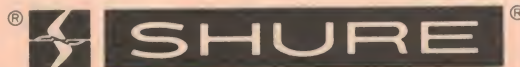
Model	Stylus Configuration	Tip Tracking Force	Applications
M97HE	Nude Hyperelliptical	$\frac{3}{4}$ to $1\frac{1}{2}$ grams	Highest fidelity where light tracking forces are essential.
M97ED	Nude Biradial (Elliptical)	$\frac{3}{4}$ to $1\frac{1}{2}$ grams	
M97GD	Nude Spherical	$\frac{3}{4}$ to $1\frac{1}{2}$ grams	
M97EJ	Biradial (Elliptical)	$1\frac{1}{2}$ to 3 grams	Where slightly heavier tracking forces are required.
M97B	Spherical	$1\frac{1}{2}$ to 3 grams	
78 rpm Stylus for all M97's	Biradial (Elliptical)	$1\frac{1}{2}$ to 3 grams	For 78 rpm records.

Shure has written a new chapter in the history of affordable hi-fi by making the space-age technological breakthroughs of the incomparable V15 Type IV available in a *complete line* of high-performance, moderately-priced cartridges: the M97 Era IV Series Phono Cartridges, available with five different interchangeable stylus configurations to fit every system and every budget.

The critically acclaimed V15 Type IV is the cartridge that astonished audiophiles with such vanguard features as the Dynamic Stabilizer—which simultaneously overcomes record-warp caused problems, provides electrostatic neutralization of the record surface, and effectively removes dust and lint from the record—and, the unique telescoped stylus assembly which results in lower effective stylus mass and dramatically improved trackability.

Each of these features... and more... has been incorporated in the five cartridges in the M97 Series—there is even an M97 cartridge that offers the low distortion Hyperelliptical stylus! What's more, every M97 cartridge features a unique lateral deflection assembly, called the SIDE-GUARD, which responds to side thrusts on the stylus by withdrawing the entire stylus shank and tip safely into the stylus housing before it can bend.

**NEW! M97 Series Era IV Phono Cartridges...**  
**Five new invitations to the new era in hi-fi.**



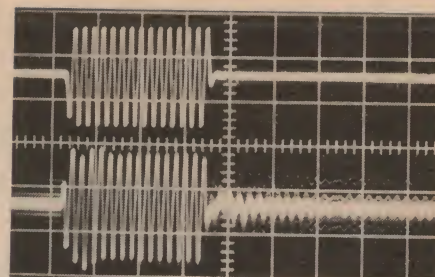
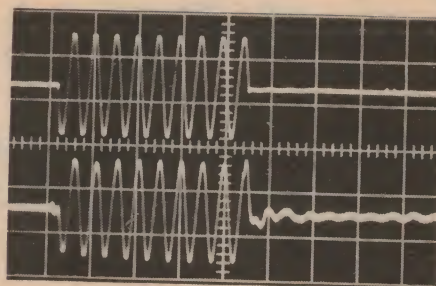
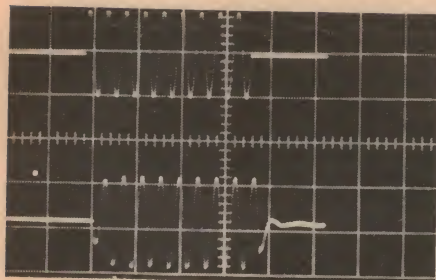
**AUDIO ENGINEERS P/L**  
342 Kent Street,  
SYDNEY 2000 N.S.W.

**AUDIO ENGINEERS (Vic.)**  
2A Hill Street,  
THORBURY 3071 Vic.

**AUDIO ENGINEERS (Qld.)**  
51a Castlemaine Street,  
MILTON 4064 Qld.

**AE 151/FP**  
**ATHOL M. HILL P/L**  
33 Wittenoom Street,  
EAST PERTH 6000 W.A.





Tone burst response of Celef mini professional SM loudspeakers. Oscillograms taken at 90 dB steady state spl at 2m on axis. Left picture shows 100 Hz burst ('scope on 20 ms/div.). Centre picture shows 1 kHz burst (2 ms/div. on 'scope) and right shows 6.3 kHz burst (0.5 ms/div.).

Our overall impression of these speakers must be related to the manufacturer's description of them. As professional speakers we would rate them as poor; considered as domestic speakers their performance is only just above average.

## CELEF MINI PROFESSIONAL S.M. LOUDSPEAKER SYSTEM

Dimensions: 585 mm H x 280 mm W x 310 mm D  
Weight: 14 kg Price \$740 rrp  
Manufactured by Celef Audio Ltd, United Kingdom.

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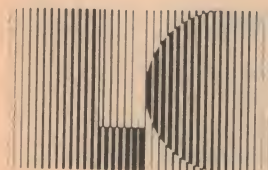
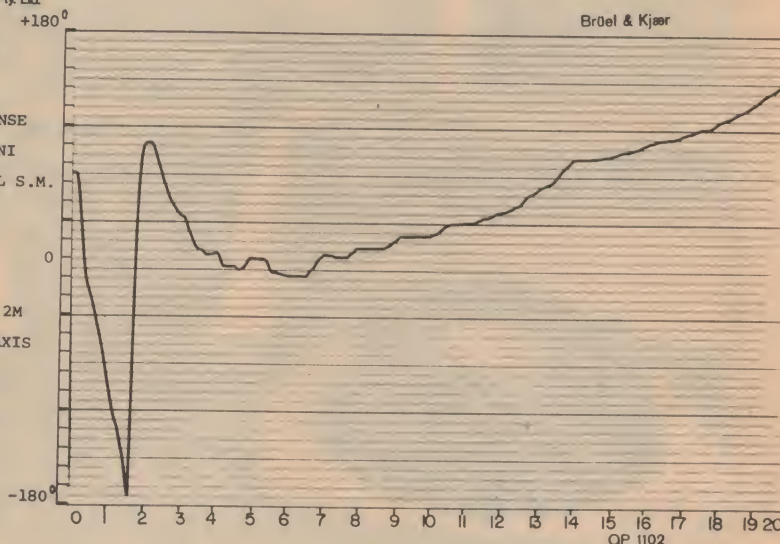
Louis A. Challis  
& Associates Pty. Ltd.



PHASE RESPONSE  
OF CELEF MINI  
PROFESSIONAL S.M.

MEASURED AT 2M  
ON TWEETER AXIS

DATE: 2/3/80



MEASURED PERFORMANCE OF  
CELEF MINI PROFESSIONAL  
S.M. LOUDSPEAKER

Louis A Challis and Associates Pty Ltd

FREQUENCY RESPONSE: 70Hz to 20kHz

CROSSOVER FREQUENCY: 2.5kHz

SENSITIVITY:

(for 90dB average at 2m) 8.8 VRMS = 9.7 Watts  
(nominal into 8Ω)

HARMONIC DISTORTION: (for 90dB at 2m)

	100Hz	1kHz	6.3kHz
2nd	-39.6	-56.6	-46.4 dB
3rd	-48	-51	46 dB
4th	-63.6	-77	-60 dB
5th	-	-75	- dB
THD	1.1 %	0.32 %	0.7 %

INPUT IMPEDANCE:

100Hz	10 Ω
1kHz	38 Ω
6.3kHz	8 Ω
Minimum at: 17kHz	6 Ω





**You can't take your home stereo with you in the car, but now you can take its sound.**

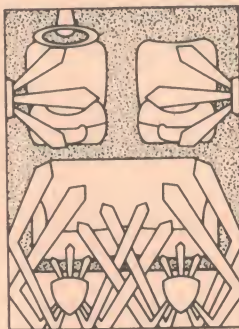
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Bose introduces the Model 1401™ Direct/Reflecting® car stereo.

Which means that now you can listen to the same quality sound when you're sitting in a traffic jam or cruising down the highway, that you hear when you're home with your stereo system.

Two Direct/Reflecting® speakers with adjustable vanes let you reflect the sound off the rear window or other solid surfaces of the car. And reflect sound the way it is reflected in a concert hall.

And two accessory speakers can be mounted in the doors to bring even greater dimension and fullness. And all speakers are



full-range speakers based on the famous Bose 901® system.

The Bose 1401 system comes with a Booster/Equalizer that boosts the power to 100 watts total when all four speakers are used. At .09% THD. And it all fits under the dash.

The system also features a Spatial Control™ to shape the sound to the acoustics of your car; active equalization for flat power radiation in the car environment; and a low frequency control.

Come in for a demonstration and drive home listening to the same quality sound you'll hear when you get there.

**BOSE®**

Australasian Distributors: Bose Australia, 11 Muriel Avenue, Rydalmere 2116, Sydney NSW. Phone 648-1022.

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**SELL:** TEAC A4300 auto-reverse RTR tape deck complete with remote control, works well, \$350. Phone Pat (02) 759-5080 a.h.

**SELL:** Trio valve dual tuner amp with SW — old type, will incl 50 Ass. valves, \$40. Phone Pat (02) 759-5080 a.h.

**WANTED:** No.4 key and shaft for Canon-Canola L100S calculator. Phone Pat (02) 759-5080 a.h.

**WANTED:** Thorens TD124 turntable any condition. Westcott (03) 630-7696 (9 - 4). For STD, give number and hang up, I'll call you. K.W. Westcott, 3 Duke St, Ashburton, Vic 3147.

### COMMUNICATIONS

**SELL:** National Panasonic DR48 radio, New World Reception 10 Band MW, FM, LSB, USB, ANL, digital frequency counter, perfect working \$360. Phone Walter Zagora (03) 375-3690.

**WANTED:** R.1155-N, Ex-R(A)AF Communications Receiver, preferably working but other condition/model acceptable. I have appropriate manual. John Lavender, 3 Raw Place, Farrer, ACT 2609. Phone (062) 86-4029.

**FT901DM YAESU HF Transceiver** with CW, AM filters, microphone, brand new (unopened carton) \$975. Alpha ETO 374AE HF 1-30 MHz linear amplifier made USA; 2 kilowatt dc output power. Manual/auto tune, \$2,095. James Goodger (02) 36-7756 or (02) 799-5566. G.P.O. Box 5076, Sydney, NSW 2001.

**Kempronic Base Station 18Ch SSB/AM EC.** Built in clock and SWR, covers 27.005 27.225, ant. inc. Suit novice use. \$250 o.n.o. Phone (03) 459-0607 a.h. 14 Ferguson St, MacLeod, Vic 3085.

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**CASIO FX-502P owners:** anyone interested in forming users group to sell/swap programs? Send SAE, suggestions to Clive Conway, 80 Third Ave, Joslin, SA 5070.

**TRS-80 L2 s'ware** — fantastic games, etc (approx \$70 worth) — will swap for light pen, Edit/Ass. prog. or other software. R. McCance, 4 Morris Av, Taroona, Tas 7006.

**SELL:** Keyboard (encoded), VDU board (EME-1), cursorboard, p/s, case w. connectors/switches. \$250 o.n.o. (working). J. Brandwyk, 184 Coromandel Pde, Coromandel Valley, SA 5051. Phone (08) 278-5163.

**WANTED:** Video cartridges for Fairchild channel F, nos. 1, 4, 5, 9, 11, 12, 14, 15. R. Stuart, 19 Lancaster St, Dianella, WA 6062.

**SELL:** Centronics P1 Microprinter together with 26 rolls of paper. Printer is similar to Tandy Quick Printer. \$500 complete. Bonner, 22 Clontarf St, Seaforth, NSW. (02) 94-6895.

**SELL:** G.E. 115 V sprocket feed 9 channel paper tape reader, fwd/rev circuit supplied \$65. Write C. Hallam, 29 Shaw St, Devonport, Tas 7310.

**SELL:** 6502 (SYM-1) including 4K RAM 8K BASIC 4K MONITOR housed with power supply. 2 manuals. Application book and 2 MHz 6502 chip. \$300. Brian (02) 477-2585.

**MUST SELL:** EME-1 board, some parts, wires, plans. 2650, all gold sockets etc. almost finished. Sell both \$50 or \$25 each. Benjamin Simons, 48a Malton Rd, Beecroft, NSW. (02) 848-8141.

**TRS-80 LEVEL TWO 16K RAM software, manuals, books, complete system.** \$850. T.I. Graham (03) 873-3820.

**S100 BOARDS:** 8K RAMS (2) \$120 each. 2-80 CPU \$130. Front panel \$30. Giles Puckett, 9 Alexandra St, Hunters Hill, NSW 2110. Phone (02) 89-3605 a.h.

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### MISCELLANEOUS

**DIGITAL VOLTMETER** for sale in good working condition, TRIO Model DL703, \$89. G. Kingsmill, 45 Jellicoe St, Ivanhoe, Vic 3079. Phone (03) 49-2703 after 6 p.m.

**TEKTRONIX OSCILLOSCOPE** 465 with DM 44 DMM, hardly used, \$3,700 o.n.o. Phone Paolo Colombo, (062) 58-1092.

**HELP BUSHIE BEAT BOREDOM!** TV game chips wanted, esp. 10-game and tank battle, or completed kits. E. Kepper, Bamaga, Qld 4876.

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**SELL:** Original LEAK Point one valve preamp. Electronic Assistance Corp Communications receiver type R-390A/URR plus manual. Blair Lade, P.O. Box 363, Tennant Creek, NT 5760.

**WANTED:** Liquid crystal display-Epson LD 318 for Unitrex 10 SC calculator. R.J. Hardidge, 17a Glen Shian Lane, Mt. Eliza, Vic 3930. Phone (03) 787-6898 a.h.

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1. Loudspeaker Systems. Either fully built by Audax or in well designed, easy to construct kit form. Laboratory designed to show off some of the better known Audax components these systems are available from selected specialist Hi Fi retailers.
2. For the specialist constructor (manufacturer) the superb Audax driver range is now available together with help and advice when required from our Australian and French offices. A cabinet factory has recently been established in Huntingdale Victoria. This factory will be able to construct speaker cabinets to top European standards. Manufacturers interested in this facility are invited to phone or write for more information.
3. For the Kit builder. Recently a number of designs have appeared in Wireless World, Practical Hi Fi and other magazines using one or more Audax drivers. We can supply parts (including crossover networks, felt panels etc in many cases) for these designs.

Please phone or write to Audax Loudspeaker for more information on any of the above services. For those people interested in listening to one of the excellent Audax Loudspeaker Systems call us for the name and address of your nearest dealer.

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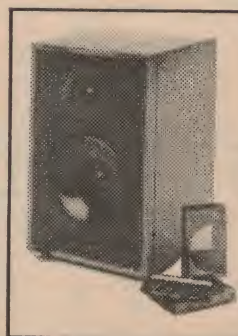
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# KITS for projects

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish. This list is a guide to suppliers of kits and components for ETI projects.

We have listed here most of the projects published over the last few years which are either available as kits or can still be made up by shopping around for components. Suppliers listed against a particular project will either stock it as a kit or stock the pc board plus the other components.

## Printed circuit boards

Those suppliers listed against specific projects here are able to supply pc boards for those projects. Printed circuit boards for every project ever published in ETI are available through the following companies (to the best of our knowledge):

RCS Radio      Radio Despatch Service  
651 Forest Rd    869 George St  
Bexley NSW      Sydney NSW 2000

For current projects and a more comprehensive list of pc board suppliers refer to the Shoparound page in this and previous issues. This list will be updated roughly every four months.

## Key to Companies

- A Applied Technology Pty Ltd, 1A Pattison Avenue, Waitara, NSW 2077. Ph. (02) 487-2711.
- B Bill Edge Electronic Agencies, 115 Parramatta Road, Concord (PO Box 1005, Burwood North 2134). Ph. (02) 747-6472.
- C J.R. Components, PO Box 128, Eastwood, NSW 2122. Ph. (02) 85-3976.
- D Dick Smith Electronics P/L, Cnr Waterloo & Lane Cove Roads, North Ryde, 2113. Ph. (02) 888-3200.
- E All Electronic Components, 118 Lonsdale Street, Melbourne, Vic 3000. Ph. (03) 662-3506.
- F Tasman Electronics, 12 Victoria Street, Coburg, Vic 3058. Ph. (03) 354-5062.
- J Jaycar Pty Ltd, PO Box K39, Haymarket, NSW 2000. Ph. (02) 211-5077.
- K S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109. Ph. (03) 842-3950.
- L Ellistronics, 289 Latrobe Street, Melbourne, Vic 3000. Ph. (03) 602-3282.
- M Mode Electronics, PO Box 365, Mascot, NSW 2020. Ph. (02) 666-6324.
- N Nebula Electronics Pty Ltd, 15 Boundary Street, Rushcutters Bay, NSW 2011. Ph. (02) 33-5850.
- O Orbit Electronics, PO Box 7176, Auckland, New Zealand.
- P Pre-Pak Electronics, 1A West St, Lewisham, NSW. Ph. (02) 569-9797.
- R Rod Irving, PO Box 135, Northcote, Vic 3070. Ph. (03) 489-8131.
- V Silicon Valley, 23 Chandos Street, St. Leonards, NSW 2065. Ph. (02) 439-4655.
- W Willis Electronics, 993 Hay Street, Perth, WA 6000. Ph. (09) 321-7609.
- Y Trilogy, 40 Princes Highway, Fairy Meadow, NSW 2519.

## Project Electronics

041	Continuity Tester	W,R,D,B,Y,L
042	Soil Moisture Indicator	R,B
043	Heads or Tails Circuit (Oct 76)	W,R,D,E,A,F,B,Y,L
044	Two Tone Door Bell (Oct 76)	W,R,D,E,O,A,F,B,Y,L
045	500 Second Timer	W,D,E,A,B,Y,L
047	Morse Practice Set	W,D,O,A,B,Y,L
048	Buzz Board	W,D,A,B,Y,L
061	Simple Amplifier (Oct 76)	W,R,D,E,A,B,Y,L
062	Simple AM Tuner (Mar 77)	W,D,E,B,Y
063	Electronic Bongos	R,D,A,B,Y,L
064	Simple Intercom (Nov 76)	W,A
065	Electronic Siren	W,R,D,E,O,A,B,Y,L
066	Temperature Alarm (Dec 76)	W,D,E,A,B,Y,L
067	Singing Moisture Meter	D,B,Y
068	LED Dice Circuit (Oct 76)	Y,W,R,D,E,A,B,L
070	Electronic Tie Breaker (Jan 77)	
071	Tape Noise Limiter (Jun 78)	R,E,F
072	Two-Octave Organ (Jun 78)	W,D,B,Y
081	Tachometer (Mar 77)	W,E,O
082/		
528	Intruder Alarm	W,R,E,A
083	Train Controller	Y,W,R,E,L
084	Car Alarm	W,R,D,E,A,B,Y,L
085	Over-rev Alarm	W
086	FM Antenna	W
087	Over-LED	Y,W,E
088	Hi-Fi Speaker	W

## Test Equipment

132	Experimenter's Power Supply (Feb 77)	E,O
133	Phase Meter (Apr 77)	E
134	True RMS Voltmeter (Aug 77)	E
135	Digital Panel Meter (Oct 77)	E
136	Linear Scale Capacitance Meter (Mar 78)	
137	Audio Oscillator (May 78)	W,D,E
138	Audio Wattmeter (Nov 78)	E,B
139	SWR/Power Meter (May 78)	
140	1GHz Frequency Meter-timer (Mar 78)	C
141	Logic Trigger (Jan 79)	E
142	High Current Power Supply (Feb 79)	W,E
143	Curve Tracer (Jan 79)	W
144	Expanded-scale RMS Voltmeter (Jun 79)	E
148	Versatile Logic Test Probe (Jul 79)	E,L

## Simple Projects

243	Bip Beacon (Apr 77)	
244	Alarm Alarm (Feb 77)	F
245	White Line Follower (Nov 77)	F
246	Rain Alarm (Apr 78)	F
248	Simple 12V to 22V Converter (Jul 78)	W
249	Electronic Combination Lock (Apr 79)	E
252	The Passionmeter (Aug 79)	
253	Electronic Grenade (Hot Potato) (May 79)	
254	Egg Timer (Jun 79)	Y,W

## Motorists' Projects

316	Transistor Assisted Ignition (May 77)	W,E,O,K
317	Rev. Monitor Counter (Jul 77)	E
318	Digital Car Tacho (Jul 78)	W,E,K
319	Variwiper MK II (Sep 78)	W,E,O
320	Battery Condition Indicator (Apr 79)	Y,E,L

## Audio Projects

448	Disco Mixer (Nov 76)	W
449	Balanced Microphone Amp (Nov 76)	W,D,E,J,F,Y
450	Bucket Brigade Audio Delay Line (Dec 77)	W,E
451	Hum Filter (Jul 79)	D,E,F
470	60 W Amp Module (May 79)	Y,W,R,E,F,B,P,L,A,V
471	High Performance Stereo Preamp Control Unit (Jun 79)	W,R,E,F,B,P,A,V,L
472	Power Supply — the Series 4000 Stereo Amp (Jul 79)	W,R,E,F,B,V,L
473	Series 4000 Moving-coil Cartridge Preamplifier	F,J
480	50-100 Watt Amp Modules (Dec 76)	W,R,D,E,J,O,Y,L
481	12V 100 Watt Audio Amp (May 77)	R,E
481	High Power PA/Guitar Amp (Jun 77)	W
482	Stereo Amp (Jan 77)	O,E
482	Stereo Amp Part 2 (Feb 77)	O,E
483	Sound Level Meter (Feb 78)	E
484	Simple Compressor Expander (Jul 77)	E
485	Graphic Equaliser (Jun 77)	Y,W,E,J,O
486	Howl-round Stabiliser (Nov 77)	J
487	Audio Spectrum Analyser (Feb 78)	E
489	Audio Spectrum Analyser 2 (Apr 78)	E,J
490	Audio Compressor (Dec 78)	
491	Simple Graphic Equaliser (Mar 79)	W,E
495	Transmission Line Speakers (Aug 77)	

## Miscellaneous

546	GSR Monitor (Mar 77)	W,E
547	Telephone Bell Extender (Jun 77)	E
548	Photographic Strobe (May 77)	W,E
549	Induction Balance Metal Detector (May 77)	Y,W,D,E,L
550	Digital Dial (Aug 78)	E,O
551	Light Chaser (Sep 78)	W,E,O
552	LED Pendant (Sep 78)	
553	Tape/Slide Synchroniser (Oct 78)	E
556	Wind Speed/Direction Indicator (Dec 78)	
557	Reaction Timer (Feb 79)	E
558	Mast-head Strobe (Feb 79)	E
559	Cable Tester (Mar 79)	
575	Portable Fluorescent Light Wand for Car, Camping (Aug 79)	W
577	General Purpose Power Supply	J
581	Dual Power Supply (Jan 77)	W,E,Y
582	House Alarm (Jul 77)	W,E,O,A
	House Alarm — Installation Instructions (Aug 77)	W
583	Marine Gas Alarm (Aug 77)	D,E,M
585	Ultrasonic Switch (Sep 77)	R,D,E,O,F
586	Shutter Speed Timer (Oct 77)	E
587	UFO Detector (May 78)	
588	Theatrical Lighting Controller (Nov & Dec 77 Jan & Mar 78)	N
589	Digital Temperature Meter (PCB135) (Dec 77)	E
590	LCD Stopwatch (Oct 78)	O,N
591	Up/Down Presettable Counter (Jul 78)	D,E
592	Light Show Controller (Aug 78)	E
593	Colour Sequencer (Dec 78)	
594	Development Timer (Apr 79)	E
595	Aquarium Lamp Controller (May 79)	

## Electronic Music

602	Mini Organ (Aug 76)	W,D,E,Y
603	Sequencer (Aug 77)	W
604	Accented Beat Metronome (Sep 77)	E
605	Temp Stabilized Log-exponential Converter (Sep 78)	

## Computer Projects

630	Hex Display (Dec 76)	E,A
631	ASCII Keyboard (Dec 76)	W,E,O,A
631	Keyboard Encoder (Apr 77)	W,E,O,A
632	Video Display Unit (Jan 77)	E,O
633	TV Sync Generator (Jan 78)	E
634	8080 Educational/Prototyping Interface (Jul, Aug 78)	
635	Microcomputer Power Supply (Sep 77)	O
637	Cuts Cassette Interface (Jun 78)	V,E,A
638	Eprom Programmer (Jul 78)	W,E
639	Computerised Musical Doorbell (Mar 78)	A
640	S100 VDU (Apr, May, Jun 78)	W,O,A,V
641	S100 Printer (Sep 78)	O
642	16k S100 RAM Card (Feb 79)	K
650	STAC Timer (Nov 78)	E,L
651	Binary to Hex Number Converter (Jun 79)	E
680	Z-80 based CPU (Nov, 79)	A

## Radio Projects

712	CB Power Supply (Jun 77)	W,E
713	Add-on FM Tuner (Sep 77)	
714	VHF-Log-Periodic Antenna (Feb, Mar 78)	
715	VHF Power Amplifiers (Nov 77)	
716	VHF Power Amplifiers (Jan, Feb 78)	
717	Crosshatch Generator (May 78)	W,D,E,A,Y
718	SW Radio (Oct 78)	E
719	RF Field Strength Indicator (Nov 78)	
720	2m VMOS Power Amp (Jan 79)	
721	Aircraft Band Converter (Mar 79)	W,E
722	Antenna for Aircraft Band Converter (Mar 79)	
724	Microwave Oven Leak Detector (Jul 79)	D,E,E
725	Simple SSB Generator employs Polyphase Network using Standard Components (Aug 79)	E,L
730	Get Going on Radioteletype (Aug 79)	E,L

## Electronic Games

804	Selectagame (Nov 76)	O
804	Selectagame (Rifle Project) (Mar 77)	O
805	Puzzle of the Drunken Sailor (Oct 77)	
806	Skeet (Jan 78)	O
810	Stunt Cycle TV Game (Jun 78)	D,O
811	TU Tank Game (Oct 78)	O
812	Wheel of Fortune (Dec 78)	
813	Race Track Game (Jan 79)	O
814	The 'Dinky-Die' (Aug 79)	



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I think that cockerel-homing project is aligned now . . . . try that rooster tape again.



IT WAS PRECISELY 2 am on a warm, late summer's evening. The bushfires had long since petered out and no pall of smoke hung over the harbour, or the horizon, as it had done some weeks past. All slept peacefully that balmy night.

Then, one of them crowed.

Sitting bolt upright in bed, in unison with about 300 other furiously disturbed sleepers, our normally unflappable Managing Editor, Collyn Rivers, uttered a series of vile curses learned as a lad in North Africa. This was followed, about 10 dB lower and in equally intemperate tones, by incantations to the effect that something drastic, final, ultimate and **terminal** had to be done about the infernal Goat Island cockerels!

Goat Island is situated in the middle of glorious Sydney harbour, about 1 km west of The Bridge, just further than a stone's throw from Ball's Head on the north side and Balmain East on the south. Goat Island has a venerable place in Australia's history, and an interesting, if gruesome, past.

Now, legend has it that cockerels crow the dawn. So much for legend. Nobody told the 30 Goat Island roosters. Their habit is to crow on the hour, every hour commencing (on average) about midnight, every night. Even heavy sleepers of placid disposition have been seen to turn into morose, paranoid psychotics with murderous tempers.

Plan A for dealing with the roosters was to obtain a brace of ETI-466 300 watt amp modules and tapes of wolf howls (or some other predator's call) through the Bose 901 speakers Collyn had for review. Certain



arrest and arraignment for transgressing NSW's noise laws scotched that plan. Curiously, the Goat Island roosters, being Maritime Services Board employees, do not come under the noise laws' jurisdiction.

Being just over a stone's throw away, lobbing stones on the chookhouse roof was out — assuming its position was known, which it wasn't. Any direct physical method was ruled out as Goat Island is State owned. Some, more subtle — preferably electronic, method had to be devised to remove the offending cockerels, or at least get them to cease and desist. Playing tapes of thunderstorms (using aforementioned pair of ETI-466s, Bose 901s etc) was suggested — fowls seek shelter in violent storms. However, such 'cures' proved worse than the problem, — and then there were the noise laws . . . . .

Searching through the dim past, and

then his old sea chest, Collyn dug out something every boy used to make in 'the olden days' — a model aeroplane powered by a 0.5 cc combustion engine (from *Mechanix Illustrated*, May 1938). Fitted with the ETI-711 Remote Controller, it could fly suitable 'messages' to the cacaphonic cockerels so close across the water from Collyn's home. Laying a bomb pattern over the island was thought to be wasteful, though. Aha! — build a 'cockerel homing' device to guide the model aircraft to its target! (To be project 901 — watch for it, it's a cunning one).

With this marvellous device aboard, the aircraft, loaded with a miniature torpedo bomb (from *War Games Illustrated*, June 1956), could be set off at 'first crow', home in on its target and, Kamikaze-like, attenuate the problem in one blow. Being a self-destructive solution, the noise laws seemed to present no problem here.

All was readied. The plane's tank was filled, bomb primed, batteries charged.

Three am. The first crow.

A small engine was heard to sputter into life and then its drone carried out across the slumbering harbour.

Somewhere out in Fairfield, or beyond, in the shadow of the Blue Mountains, another cockerel crowed . . . at 3.02 am.

The little plane banked sharply and headed due west, 90° off course!

One Guiseppe Papadopolous, of Elizabeth Drive, Kemps Creek is still trying to work out who bombed his little corrugated iron chookhouse at 3.15 am one morning in August — and why.



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